Mirrorless Cameras • Gigapixel Images • Lightroom • Pseudo HDR / DRI

c't Digital Photography

The in-depth quarterly for the photo enthusiast

Creative Corner

Pseudo HDR and DRI
Get the most from your pixels

Painting with Light
LED photo performance art

Workshops

iPad Photo Assistant
Tablet-based shooting support

Gigapixel Panoramas
More detail than you ever thought possible

Free DVD

Light Art eBook

Digital Mega-painting Project Video

Full Version Software, Test Images

Image Processing

RawTherapee How-to
Free and powerful RAW development

Lightroom Workflow
Expert guide

7 (2012) • **$14.99**
Spring Issue

Mirrorless Camera Test
System Cameras are Coming of Age

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Photographers!

We are proud to announce a premium two-day event aimed at presenting a balanced view of the wide world of contemporary photography. Some of the world's leading photographers and educators will come together to present and discuss the art, craft, and technology of their trade.

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Visit **www.rockynook.com/photoact2012**
for more information and online registration
August 24–25, 2012 Santa Barbara, CA

I am continually amazed by the endless creative possibilities offered by digital imaging technology: this issue's article (page 88) by light artist JanLeonardo Woellert shows how he combines light art and photography to create a completely new form of expression. Our article also gives you exclusive inside information on how these fantastic images are created and tells you how to get started making your own.

Bert Monroy's 'Times Square' digital mega-painting is equally amazing, but more difficult to mimic! The artist spent four years creating and breathing life into a completely digital version of New York's most famous square. Our article (page 18) introduces you to the project, and our exclusive video tutorial on this issue's free DVD gives you the inside track on the background, the tools and the techniques used to complete this unique mega-project.

From 'mega' to 'giga': the first time I zoomed into a gigapixel image of Paris, from an overview of the city to a single peg on a clothesline, I was sure that I had stumbled on a technique that is either incredibly complex, prohibitively expensive or both. However, the hundreds (or sometimes thousands) of source images that make up these incredible images test the limits of computing power but can be stitched together using software that is often free (page 26).

And digital technology is making inroads into your favorite photo magazine too. In addition to the print and iPad app versions (www.ct-digiphoto.com/iPad), *c't Digital Photography* is now also available in a Zinio edition for Android, Windows and Mac at www.ct-digiphoto.com/zinio.

The choice is yours – you can subscribe to the print version and get access to all iPad issues for free, or you can subscribe to just the iPad or Zinio versions. And for good measure, you can buy single issues in all three formats too.
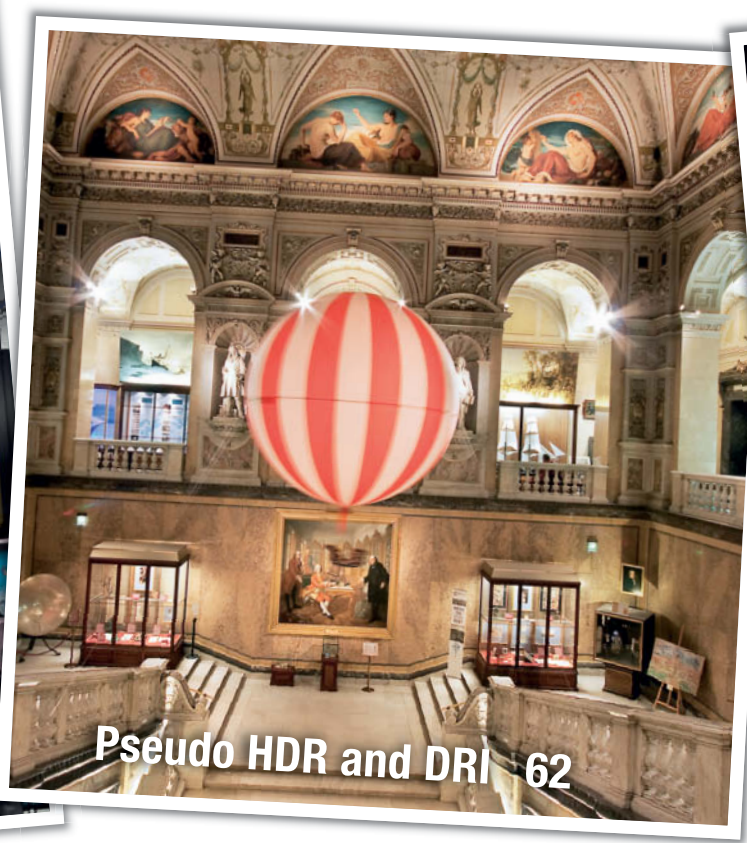
Whichever version you're looking at, I wish you a great read and lots of fresh photographic ideas!

Juergen Rink (editor)

P.S. Have you heard about the photoact 2012 conference? Together with our partner Rocky Nook Inc., c't Digital Photography is staging a unique photo event in August of this year in sunny Santa Barbara, CA. For details, visit www.rockynook.com/photoact2012.

Portfolio

Martin Stranka is a bright new star on the international scene. We spoke to him about his own special brand of photographic art.

Bert Monroy's Digital Magic

Bert Monroy spent four years working with Illustrator and Photohsop to produce an incredible digital painting with almost 500,000 layers. He tells us how the project came about and how he approached the mammoth task of turning the idea into reality.

Gigapixel Panoramas

Gigapixel shooting and stitching techniques can be used to produce images with unbelievable depth of detail. This article shows you how to produce and present gigapixel images, and tests the limits of human and machine in the process.

iPad Photo Assistant

The iPad is a great tool for viewing, keywording and even processing digital images on location. This article introduces the best apps and accessories for harnessing your tablet during a shoot.

Pseudo HDR and DRI

This comprehensive workshop covers all aspects of shooting, processing and tone mapping HDR and DRI images made from single source images.

Light Art Performance Photography

LAPP is a unique symbiosis of photography and light art performance and is rapidly becoming a worldwide phenomenon. This article takes a look at the origins of the genre and the techniques used to produce these fantastic images.

Painting with Light 88

Mirrorless Camera Test 102

System Camera Test

This issue's camera test takes a close look at some of today's high-end and mid-range mirrorless cameras and compares them with the compact competition.

Free RAW Processing

RawTherapee is a donationware RAW developer bursting with features. This article guides you through the options on offer and shows you how to apply them to your images.

The Lightroom Workflow

Lightroom includes a wide range of high-end features that simplify digital asset management and help you to produce better results. This article shows you around the workflow and gives you tips on getting the most from the software.
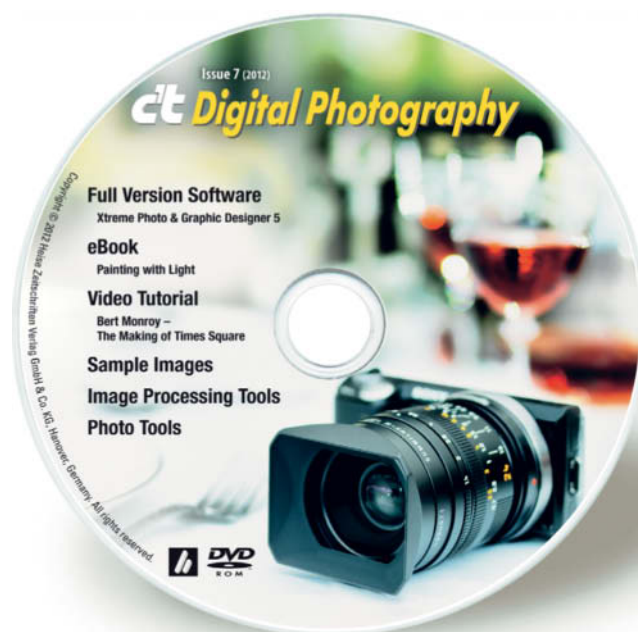
About Us

Free DVD

Readers' Letters

No Bias

Just wanted to say that I love your magazine and think the way you approach the camera reviews are the way is should be done – technical, with no bias for one brand or another. Well done indeed.

Richard Haas

Panorama Equipment Missing

I saw your magazine on the newsstand and bought it. It is an excellent product. The article by Ralph Altmann entitled 'Shooting and Stitching Panoramas' was well done except – no mention was made of the Really Right Stuff line of fine panorama equipment.

Art Lund

Sorry, but we can't test all the equipment out there! We have to restrict ourselves to a representative choice for an article like this. Really Right Stuff is indeed fine gear.

Magazine for Grown-ups

It seems that at last someone has produced a photo magazine for 'grown-ups'! I have only seen one edition so far, but the articles in Issue 6 are so good and in-depth plus with a really useful DVD, that I shall be ordering it from now on. I have just a minor comment that you might consider incorporating in your camera tests. With an ever-growing variety of sensor sizes in the new camera models being introduced, rather than using the existing system (1/2", 1/2.3" etc.) that I'm sure must confuse many people, would it be possible to simply state the actual dimensions in millimeters so that comparisons can be made? Looking forward to the next issue.

David Piper

Intelligent Content

Many thanks for the c't Digital Photography magazine, it's great to read and has intelligent content that's aimed at both photography and the digital darkroom. I've only just discovered it here in Finland, in fact I've only seen it at one particular shop in the center of Helsinki, so I've made sure to order the yearly subscription.

Francis Hart

Where Can I Get Issue 2?

I would like to congratulate you on your high-quality magazine that has so much more to offer than the competition! I have ordered a subscription and I will be recommending it at all of our photo club meetings.

It's just a shame that we can no longer order Issue #2. Is there any way to get hold of a copy?

Johan Vanhauwaert

Sorry, but issue #2 is completely sold out. However, all issues are available for purchase digitally, either using our iPad app or through Zinio (see the links below). The Zinio reader is available for a large variety of operating systems and mobile devices.

iPad app: www.ct-digiphoto.com/iPad

Zinio edition: www.ct-digiphoto.com/zinio

… and what people are saying about us on the Web:

Get c't Digital Photography Magazine – It's Damn Good

After taking a look at a few issues, we have to say that this new magazine has shot up our list of favorites and is now on our 'must buy' list when we hit the newsagent.

Here's why you'll probably like it too: For starters it is detail-heavy. Every article is meticulously explained and has several examples and often explanatory diagrams of the more important aspects of the subject. In fact, the featured articles in each edition read more like a series of mini-guides.

The beauty of that approach is that even veteran shooters will probably learn something or at least be reminded of some important aspects of the particular subject being covered. These are photography articles for information junkies.

While a lot of photography magazines emphasize flashy graphics and beautiful design (which isn't necessarily a bad thing), c't Digital Photography emphasizes hardcore, actionable information about the technique and theory of various facets of photography. It has its fair share of great photography too.

www.lightstalking.com/c-t-digital-photography

Light Stalking

A Bit Different

I came across this magazine and website, and they appear to be 'the business', as it were. So many magazine formats for photography are just full of stuff you already know and equipment reviews that are just not interesting. This one looks a bit different and you might like to check it out. As the cover says 'in-depth' and I think that is correct, fulsome in detail and information.

https://oxfordschoolofphotography.wordpress.com/2011/12/01/ct-digital-photography-magazine/

Oxford School of Photography

Tell us what you think:

We are always happy to receive your comments and suggestions in a letter, an e-mail to editor@ct-digiphoto.com or at www.facebook.com/ct-digiphoto. We reserve the right to abbreviate your input for publication. Our comments are printed in italics.

You can learn it.™
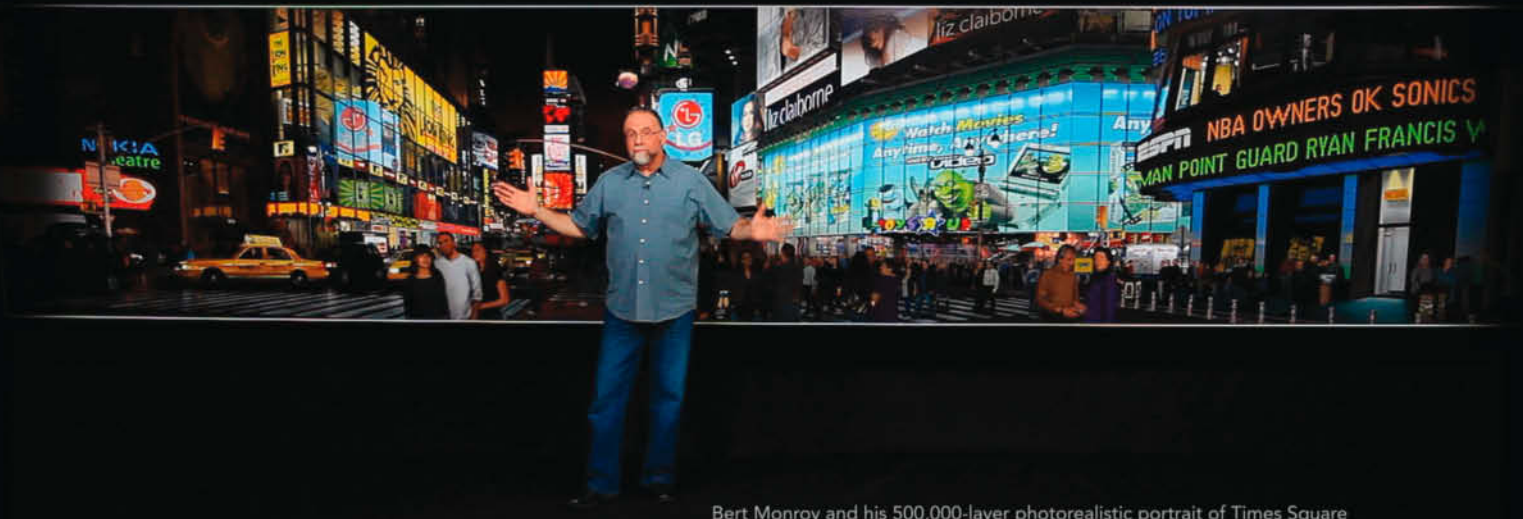
Bert Monroy and his 500,000-layer photorealistic portrait of Times Square

Tour *Times Square*—then explore the many layers of lynda.com.

Taught by experts like Bert Monroy, our high-quality video tutorials reveal the latest Adobe Photoshop tools and Illustrator techniques. Try our **free 7-day membership** for unlimited access to training in design, photography, audio, video, animation, and more.

Start learning today: **www.lynda.com/trial/ct-digitphoto**

lynda.com
Online Video Library

DVD Highlights

Highlights of this issue's free DVD include a complete eBook on light art photography, sample images from the articles and tests in the magazine and a free full version of Magix *Xtreme Photo & Graphic Designer*. Our additional high-end video material includes a multi-part video tutorial by Bert Monroy on the making of his astonishing 'Times Square' digital mega-painting.

Bert Monroy – The Making of Times Square

Video Tutorial: In addition to this issue's article (see page 18), Bert Monroy uses this multi-part video tutorial to give you the low-down on many of the techniques and tricks he used to create his digital masterpiece with its 500,000 layers and monumental levels of detail.

This issue's eight-page article tells you how Bert Monroy created his fantastic digital mega-painting of Times Square. As a bonus, lynda.com has kindly given us access to excerpts from their amazing video documentary of the project. These 18 video clips introduce you to the artist and take you step by step through the processes involved in the creation of this one-of-a-kind masterpiece.

Monroy gives you background information on the project and on the tools he used during the project. One of the most important of these was his Cintiq hybrid graphics tablet/display, which has 1024 different degrees of pressure-sensitivity and allowed him to paint directly into the monitor image. Such a device device can, for example, be used to draw the boughs of a tree in a natural and intuitive way. Monroy also spends an entire chapter explaining how he creates his own brushes and tells you how he went about organizing this mammoth project with its half-million separate layers.

The artist zooms into many of the painting's details in the course of the videos, revealing a truly astounding degree of resolution. Every single object, whether large or small, background or foreground, was created with the greatest care and precision, and individual video clips explain how dirt and grime effects, realistic-looking clothing seams, trees and asphalt were created.

The second section delves deeper into individual techniques and explains Monroy's approach to working with reference material and how he establishes perspective in his objects. This section also details how individual elements, such as the spotlights illuminating a billboard, were created.

The third and final section concentrates on the people in the painting. Monroy explains in detail how he created the outlines of his figures as well as eyes, lips, noses and various other features. He also gives you inside information on who the people are and how they came to be part of his picture. These include his wife and kids and many of his friends and acquaintances.

The full-length versions of all three videos can be found at Lynda.com. (jub)

Xtreme Photo & Graphic Designer 5

Full version software: This all-in-one package combines powerful photo editing, cataloging and editing tools in a single, easy-to-use interface.

This package is something of a Swiss Army Knife for digital photographers, and allows you to create vector illustrations and design templates as well as edit your photos from the comfort of a single interface.

The Photo Designer component includes a range of powerful filters and tools for optimizing image brightness, saturation, contrast and sharpness, as well as a red-eye correction tool and content-aware rescaling for making smart adjustments to individual image elements. The built-in Reallusion FaceFilter beautification functionality allows you to quickly and automatically create and adjust individual facial features and remove a range of common facial blemishes. The Photo Manager component includes functionality for viewing, sorting, cataloging and burning photo collections to CD and DVD, as well as slideshow production and online publishing tools.

Please register the software inside of seven days after installation by entering your e-mail address. Once you have registered, the software will remain fully functional forever. (jub)
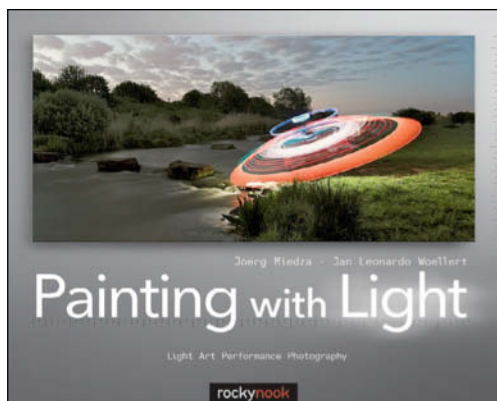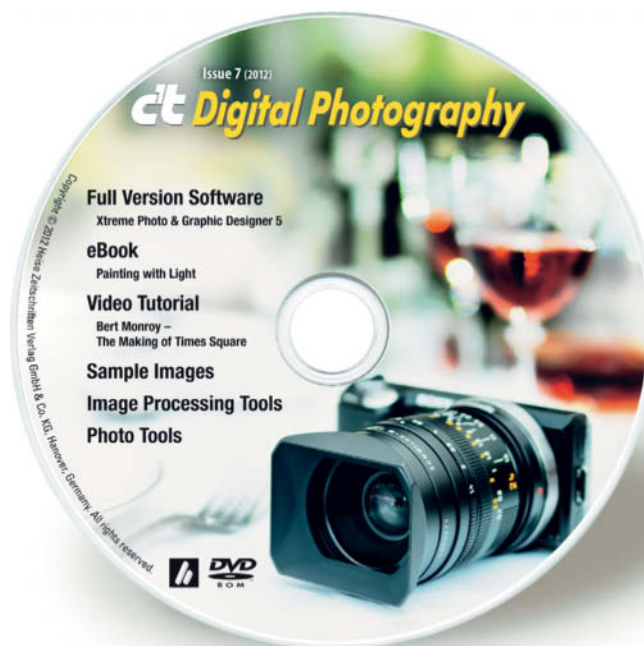
Painting with Light

eBook: This eBook covers the background, development and technique of Light Art Performace Photography.

Light Art Performance Photography, or LAPP for short, is an art form invented by German photographers JanLeonardo Woellert and Joerg Miedza. It combines light painting with complex sequences of precisely choreographed movements.

Woellert and Miedza's art is the subject of interest and appreciation all over the world and their images have received various awards, including the German national prize for scientific photography.

Our article on page 88 introduces LAPP and some closely-held secrets of LAPP shooting techniques, while the eBook itself goes into detail on the evolution of LAPP and includes two galleries of spectacular, large format LAPP images. The final section offers some basic tips to get you started creating your own LAPP artworks.

The large-format, full-color print version of the book is available for US$39.95 from www.rockynook.com, and you can find more information about the artists at www.lapp-pro.de. (jub)

Full Version Software

Xtreme Photo & Graphic Designer 5

Video Tutorial

Bert Monroy –
The Making of Times Square

eBook

Painting with Light – Light Art Performance Photography

Image Processing Tools

easyHDR Basic
FDRTools Basic 2.5.1
Fotomatic 1.4
GIMP
GIMP Portable 2.6.11
GREYC's Magic Image Converter (G'MIC)
HeliosPaint 1.4.5
ImageMagick
ImageMagick Portable 6.7.4
LiveQuartz
Luminance HDR 2.2.0
Perspective Transformations 8.0
Phatch 0.2.7.1

Photomatix Pro
Photomatix HDR Presets
PSPI for GIMP
Raw Photo Processor 4.4.2
RawTherapee
Seashore 0.5.1
UFRaw 0.18
Wire Worm 6.1

Photo Tools

Enblend/Enfuse
EnfuseGUI 2.1.2
Exif Pilot 4.4
Exif Untrasher 1.4.3
ExifTool 8.76
HD View SL 1.2
MacPorts
WIA-Loader 1.7.1.0
WIA-Loader Portable 1.7.1.0

Sample Images

Camera Test Sample Images
Gigapixel Links

Portfolio
Martin Stranka

Martin Stranka is 27 years old and lives in Prague. He only started taking photographs a few years ago, is completely self-taught and already exhibits his work in galleries around the world. His single-mindedness, his unique visual language and the magical quality of his images are the major factors that have shaped his rapid rise to fame. In this interview, he gives us some fascinating insights into his art, his work and his thoughts on photography.

c't DP: What equipment do you use?

Martin Stranka: Although I really like the look of analog photographs, I use a full-frame Canon EOS 5D with 17-40mm and 70-200mm Canon zooms and a 50mm f/1.4 standard lens. I also have a working Flexaret TLR at home that was given to me as a gift, but I haven't yet had time to explore its secrets.

How do you like to organize your shoots? Do you work with assistants?

The process of capturing photos is an ethereal experience. The moment before I release the shutter is one of trance and utter silence in which I can properly gather my thoughts. My photography is all about getting intimate with very personal matters. That's why I like to work alone with the model when I am shooting for my personal portfolio. When I am shooting for commercial clients, I am surrounded by all sorts of helpful people and useful things that I really appreciate when they're there.

Do you wait for the right moment to occur of its own accord? How do you prepare yourself for your subject?

Many of my photos are the result of ideas that start life in my head, but are nevertheless influenced by the magic of the moment. I let the locations and the models I work with inspire me. Some photographers work with intricate sketches and like to completely plan a shot in advance, which is a legitimate approach for commercial shoots. Personally, I tend to work slowly and take only very few photos. I take pictures at moments when I need to express myself and escape from reality, and these are moments that cannot be scheduled. That's just how life is – you can't plan it.

Earning a living as a photographer isn't easy. How have you managed to turn photography into your profession so quickly?

To answer this question I need to tell you how it all started: I remember very clearly the first time I picked up a camera about five years ago. I immediately fell in love with photography, although at the time I didn't think about making a living doing it. In the

Close

five years since, photos have become an addiction and a necessity. It was about a year ago that I decided to abandon the traditional nine-to-five routine and follow my dream. It worked for me, but I know that it's not easy to turn this particular dream into reality. I am very grateful for the opportunity.

People often ask me how I managed to turn professional within such a short space of time. I have always tried to follow my instincts, which tell me to be myself, be loved by a few and not worry about whether

the rest of the world understands me. I think that's part of the secret of success. Commercial photography is potentially quite boring but luckily, my clients allow me to bring my own style into each project. I have created book covers for big New York publishers like Harper Collins or Sterling, and I have worked with a number of other publishers, record companies and individual artists around the world. It is always a really rewarding experience to combine art with commercial photography.

The Czech Republic has a long photographic history and has produced many outstanding traditional, avant-garde and contemporary photographers who have had a great influence on photography all over the world. Can you explain the boundless creative energy that emanates from your country?

That's a really interesting question! I have no idea why so much creativity comes from such a small country. Prague is a truly unique

city for sure, and has its own very special charm. The old city is full of narrow streets that come alive and engulf you in their atmosphere, especially at night when they are lit by wall-mounted torches.

Many famous Czech photographers achieved their success before the second World War, although the war itself and the forty years of communist rule that followed provided strong reasons to document the events that occurred and to escape into the world of photography.

Where can people view or purchase your work? Do you present your photographs online or only in galleries? Which formats do you prefer?

I have been lucky enough to be able to exhibit internationally and I've had solo and group exhibitions in North and South America as well as in Europe and Asia. My photos are often sold at charitable auctions that are associated with my exhibitions. This approach gave me the chance to exhibit in Hong Kong, for example.

Nowadays, an artist has to have an online presence. The Internet and social networks have become really powerful tools for presenting photographs. Most buyers find me via the Internet and purchase prints from my website. I make prints that range from 20 × 20 cm right up to 150 × 150 cm. I like really big prints – in fact, the bigger the better. I really love big rooms in which you can hang a single, huge photo that decorates the entire space.

The intellectual depth of your work surprised me in view of your relatively young age. You seem to know a lot about life, and not all of what you know is based on happy experiences. I don't want to get too personal, but was there perhaps some dramatic event that led you to pursue an artistic career?

People often ask me when and why I started to take photos. And yes, five years ago I lost someone very close to me. This event turned my life inside out and made me much more aware of what was going on around me. At first, I couldn't cope with what happened, and I am still fighting the aftermath today. Photography became a kind of valve. I recently noticed that my entire portfolio is full of references to the accident, although it was never my intention to work that way. Water, people on cliffs, people levitating.

Meet Me Half Way

Someone Like You

I Was Falling High

That's all I want to say really – I always feel naked when I try to explain why I take photos.

Why do your images show so many people levitating?

I see human legs as a kind of connection that bind us to the material world. Levitating a few inches above the ground is a metaphor for liberation from the material world. If someone should ask me how I imagine silence, peace and balance captured in a single photograph, I would show them my photograph 'Close': A person levitating a few inches above the ground, eyes closed, driven by a stream of air with floating leaves in the background.

I only have one photo that doesn't have a human subject. Portraying people is a powerful way to express emotion and symbolize the internal communication of mankind with itself. In my photographs, I try to highlight the person as an individual in relation to the natural environment rather than to an artificial group. In short – an inner dialog with yourself.

You like fallen leaves, don't you?

I am a leaf addict. It's all connected with the event that occurred five years ago. The smell of autumn leaves is my one really strong memory of that time. I simply love the smell of the first two or three weeks of autumn, when the air is still warm and the leaves begin to fall – that might sound strange, but it's true. I would have autumn all year round if I could.

The phrase "inner world" is often used by people interpreting your work, inspired by the intimate feelings your photos obviously evoke. Is this a type of communication that is exclusively European? How has your work been received in other cultures?

That's an interesting question. I have honestly never thought about how my work might appear to other cultures. I have exhibited on every continent and I have never had to deal with any misunderstandings. Perhaps this is because my photos deal with emotions, and emotions are universal. My work is not based on cultural connections, political attitudes or history. I work with pure humanity and human feelings. I try to visualize the inner dialog that is part of every one of us. (jr) **ct**

Reborn

So Please Hurt Me

Bert Monroy

The Making of Times Square

How a hyper-real gigapixel digital painting is made

Bert Monroy is the co-author of the first ever book on *Photoshop* and an influential pioneer in the field of digital photorealism. He spent four years working with Adobe *Illustrator* and alpha and beta versions of *Photoshop* to produce this incredible digital painting with its almost 500,000 layers. Just as the project was finished, Monroy took time out to tell *c't Digital Photography* about some of his imaging secrets.

Free on DVD

This issue's free DVD includes more than 1^1/$_2$ hours of premium video material from lynda.com detailing the making of Bert Monroy's mega-masterpiece, *Times Square*.

The painting shows a 180-degree panorama of New York's most happening square.
The numbered yellow rectangles indicate the details explained in this article.

Times Square was a subject I had always wanted to paint, but for a long time I was unable to visualize the painting in my head. It wasn't until printers with paper widths of 64 inches became available that I realized the only way to properly capture the impact of the place was to paint it large as life. Fired up by this new direction, I set out to find the right angle and decided that a 180° panorama was the only way to go.

Though the majority of the piece was created in *Photoshop*, Adobe *Illustrator* played a key role too. *Photoshop* and *Illustrator* deal with graphics in completely different ways: *Photoshop* is pixel-based while *Illustrator* is vector-based. Each has its own unique set of

tools with a little overlap here and there, and both are open at all times in my workflow. I continuously jump back and forth between them to create my paintings.

I always perform my initial planning stages in *Illustrator*, as its vector-based operation is far more memory friendly than *Photoshop*. This was an important factor during the production of the Times Square piece, as it measures 60 by 300 inches. The perspective lines I plotted meet outside the image area and extend far beyond those measurements. To do this kind of perspective planning in *Photoshop* would require a file that is 900 inches wide, and at 360 dpi that is a file size that exceeds what *Photoshop* can

handle. *Illustrator*'s large work board makes all this possible.

The overall file was created at half the size of the final image and, once the perspective lines were established, the individual paths that make up the individual element were selected and sent to separate files where they were resized to fit into the final *Photoshop* document. Because they are resolution-independent, resizing vectors has no degrading effect n their appearance. The individual paths were copied and pasted into the *Photoshop* file. In *Photoshop*, I created a layer ofstroked paths to serve as guides for the placement of individual details. The final image was then created in *Photoshop*

The original perspective framework for the painting was created using *Illustrator* (below). The rectangle in the center marks the area covered by the finished painting. Each element was exported separately to *Photoshop* (right) before it was filled with detail (far right).
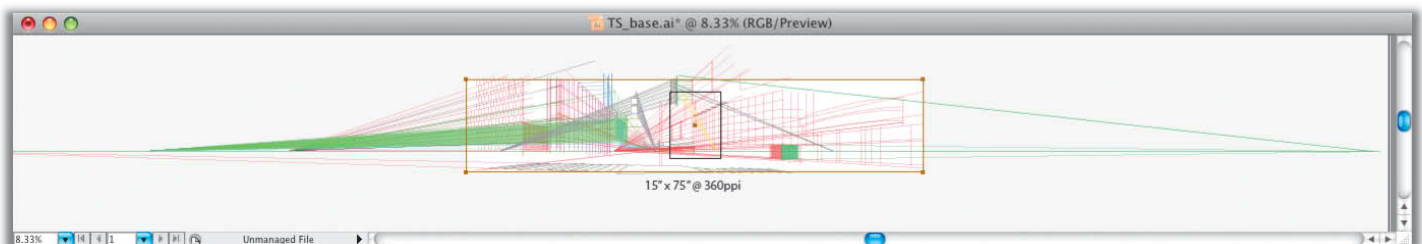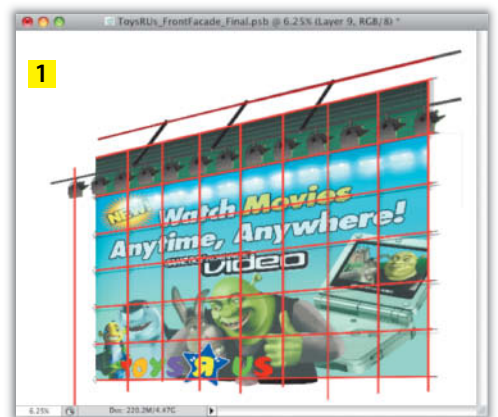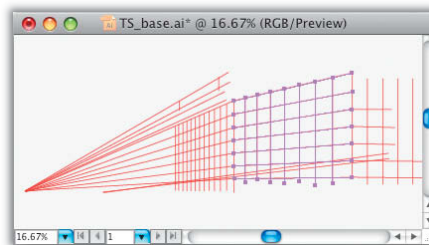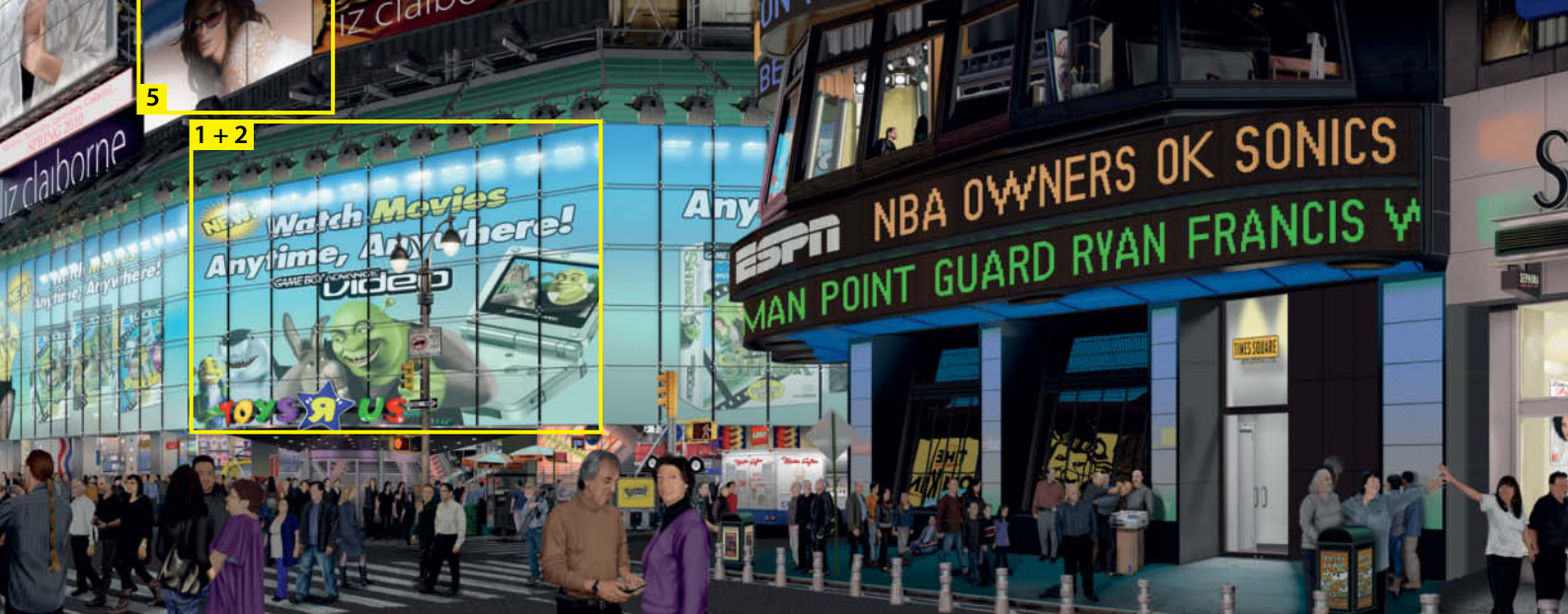
following the perspective established by these guides.

Perspective at the Click of a Button

The Blend tool is one of the *Illustrator* features that I used a lot in the course of this project. This tool creates an interpolation or a morph between two sets of paths and can blend fill color, stroke color and stroke weight. I use this tool to draw and resize multiple objects that recede within a space.

The row of lights that illuminate the Toys-R-Us storefront are all based on a single graphic object that is repeated as it recedes in to the distance. Each individual light was created on a separate layer to enable me to give each its own shadows and patina of dirt. Here, I used the Blend tool to determine the size of each lamp element.

The path for the first lamp was stroked to serve as a guide and then duplicated, reduced in size and moved into position where the final lamp should appear. I then used a blend between the two extremes using a number of steps that matched the number of lamps I wanted to create. The completed guide was then imported into a layer in *Photoshop* where each lamp was altered to the required size.

The Blend tool was also used to create many of the other elements in the scene. The McDonalds restaurant that appears up Broadway has two neon signs encased in a metal box that direct people into the establishment. As was the case with most of the elements in the image, I started creating these signs using the Pen tool. Two paths were generated to represent the two sides of the neon signs. These were then duplicated and placed below the originals and were altered to simulate the difference in viewing angles. The top pair was grouped and the

bottom pair was grouped separately to provide the Blend tool with the two separate objects it requires to do its magic. Grouping the two paths made them function like a single path, making it possible to perform the blend in a single step rather than blending each side separately.

I selected the two groups and activated the Blend command (Object > Blend > Make). After blending, I switched to Object > Blend > Blend Options and selected Specified Steps for the Spacing setting and entered 12 for the amount. The tool then interpolated the remaining paths between the four exisiting ones to create the result you can see in the illustration.

I then copied and pasted the paths into *Photoshop*. In a new "neon tubes" layer, I

stroked the paths using a white paintbrush with a small, hard edged tip and the Spacing setting reduced to 1%, which is the lowest available value. I gave the layer an Outer Glow Layer Style to make the tubes appear as if they are lit.

The Third Dimension

The new 3D functions that have been added to *Photoshop* allow you to create and alter a vast variety of incredible shapes. However, one function that is still missing is a "lathe"-type tool. This function allows you to create a cross section of a shape and have it revolve to form a three-dimensional version of the same shape. *Illustrator* has exactly this feature built in, aptly named Revolve. To
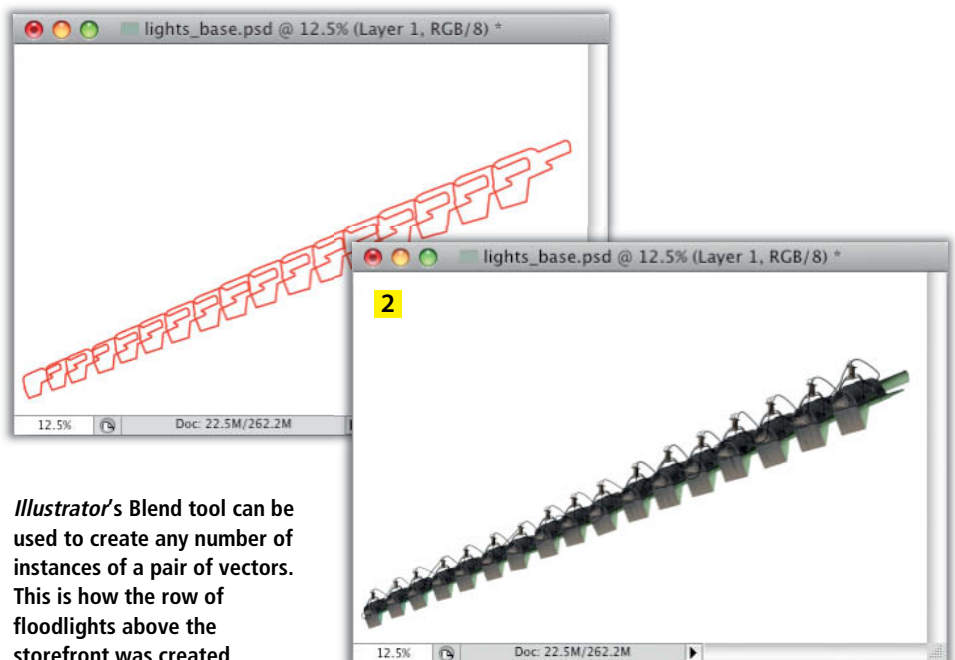
Illustrator's Blend tool can be used to create any number of instances of a pair of vectors. This is how the row of floodlights above the storefront was created.
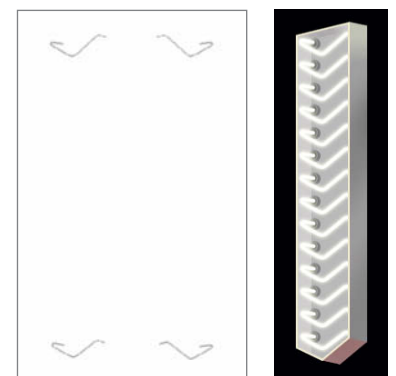
The Blend tool was also used to duplicate the neon tubes in the sign above the McDonald's door

create a simple lens-shaped disk like that of the M&Ms in the poster is quite difficult to do in *Photoshop*. In *Illustrator* it is a simple matter of creating an arc and choosing a color for the stroke or fill to determine the color of the object being rendered.

I used the Revolve tool (Effect > 3D > Revolve) to turn just such an arc into a delicious piece of candy-colored chocolate. Here, you can set the viewing angle for the object by spinning the cube in the Position section of the panel, or by entering specific degree values for the *x*, *y* and *z* axes. Perspective can be added, although in this case it would have added unwanted distortion. Multiple light sources can be created, positioned and modified to give your object the appearance you desire. Here, I set Surface to Plastic Shading to accurately simulate the candy coating of the M&Ms.

Once the object was completed, I duplicated it by dragging it while pressing the Option and Command keys (Alt-Ctrl in Windows). The viewing angle of each duplicate was altered to make them appear as individual morsels. To alter a specific shape after it has been turned into a 3D object, you have to access the 3D panel from within the Appearance panel. If you use the Effects menu as you did when creating the original effect, the settings you make will override the previous ones and start the process from scratch.

Once I had created four different colored disk sets, I selected them all and copied and pasted them into a new layer in the *Photoshop* document. Each of the four layers in the *Illustrator* document (one for each of the colors) was imported into *Photoshop* separately.

I then moved each individual piece of candy to its final position within its *Photoshop* layer and scaled some of them (Edit > Transform > Scale) to give them the appearance of being closer or further away.

I used the Motion Blur filter (Filter > Blur > Motion Blur) to make the M&Ms appear to be falling through space. I used varying Amount settings to make the upper candies appear to be falling faster than the ones below.

The final touch necessary to make all of the M&Ms appear to be falling at once was a shading effect. I created a new layer above each candy layer and used a black paintbrush to apply strokes on top of the individual candy pieces. I added varying amounts of Gaussian Blur to these strokes in a layer mask to make them appear to be at different distances from the candies they are casting their shadows onto. Adding black to the background added to the sense of depth in the finished image.

Creating Brushstrokes

The Paintbrush tool and an assortment of standard and custom brush tips were instrumental in the creation of large parts of the painting. One of the billboards you can see contains a picture of a model wearing an intricately crocheted top.

The crocheted designs were created using a series of paths created using a paintbrush with a small, hard-edged circular tip. I increased the Spacing setting in the Brush Tip Shape section of the Brushes panel (Window > Brushes) so that the circular brush tips slightly touch each other.

With the Paintbrush tool selected, I clicked the Stroke Path button at the bottom of the Paths panel. The final touch that made the threads come to life was a Drop Shadow Layer Style that made the threads look as if they were slightly raised above the surface of the skin below. I also applied a second Bevel and Emboss Layer Style with the Highlight Mode set to Multiply and the color set to medium gray to give the outer edges of the white threads a darker tone and a more authentic three-dimensional look.
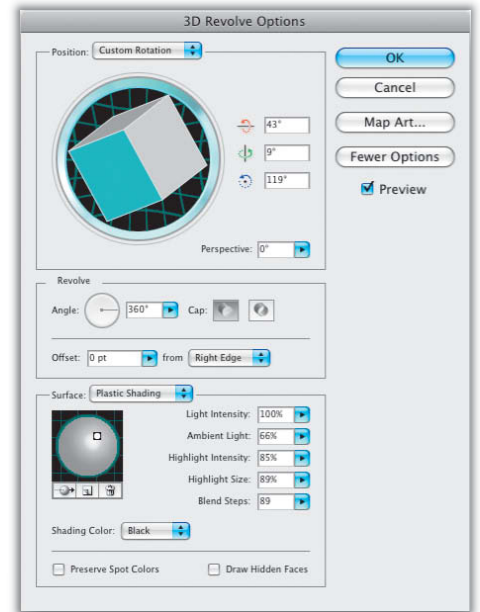
Digital Aging

There is dirt and grime all over many elements in the scene, and the myriad of billboards and signs are supported by an endless maze of girders. Creating these elaborate support systems is one thing but making them appear as if they have been there for a long time requires some extra effort.

It is important to use the right brush tip to create these weathering effects. For example, you can easily transform a photograph of a damaged surface into a very effective brush tip. Select a rectangular section of an appropriate photo of a weather-beaten stone

façade, leaving about half an inch of space at the outer edges. Adding a Feather to the selection (Select > Modify > Feather) with a setting that is high enough to soften the edges will eliminate any hard lines. If you add the feather effect using Select > Refine Edge, you can preview the effect of your Amount setting before applying it. Finally, select Edit > Define Brush Preset to transform your image into a brush tip. I modified my new brush tip in the Brushes panel to make it work the way I wanted.

In the close-up of one of the tiny bolts supporting a billboard, you can see the dirt and rust that I added using the custom brush. A wonderful new set of brush tips that emulate traditional paintbrushes was introduced with CS5. These brush tips range from fan-shaped to flat, and you can precisely control the number, length and stiffness of the bristles as well as a whole range of other attributes.

Creating a Furball

One of the billboards up 7th Avenue shows a furry ball that was created using the new Bristle Brush feature. It is quite hard to find the furball in the version of the painting printed here due to the relatively small scale of the reproduction. The large furry ball was made using the Bristle Brush, as was the title text.

The Bristle Brush is included in the regular Brushes panel, and selecting any of the Bristle

The M&Ms you can see on a poster in the background started life as a simple curve that *Illustrator*'**s 3D tools transformed into realistic-looking three-dimensional disks**

brush tips opens a set of controls in the Brush Tip Shape section of the panel that is exclusive to that particular tip. The other functions in the Brushes panel affect the brush tip as well, opening the door to some outrageous combined effects.

For the furball billboard, I selected the Round Blunt tip shape. I set Angle Jitter to

100% in the Shape Dynamics section of the panel, which gave each bristle a different angle as the brush moved over the canvas.

I chose black for the foreground color to make the resulting tip opaque. The tip then remains opaque, regardless of the Opacity setting you make for the tool once it is in use. Any color other than black will have a
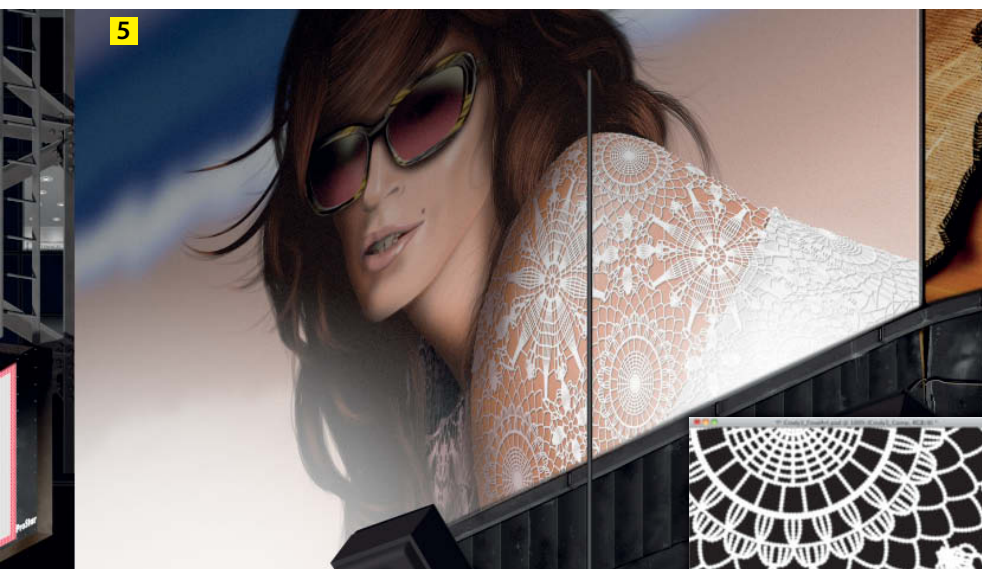
The crocheted look of Cindy Crawford's top was created using a series of paths. The Spacing setting of the brush tip was increased to make the threads appear twined.
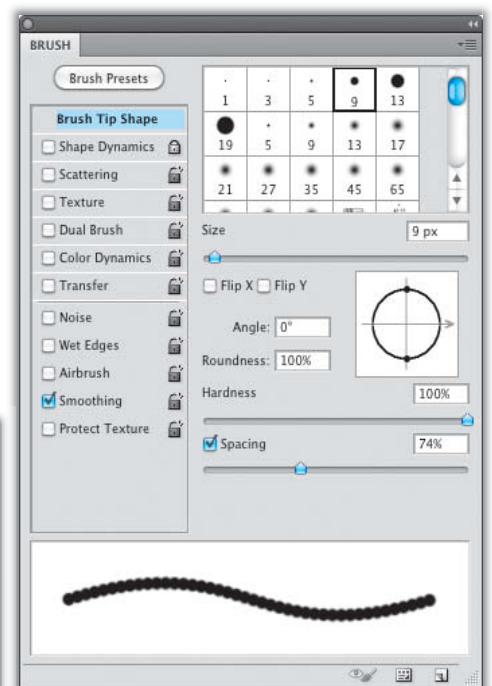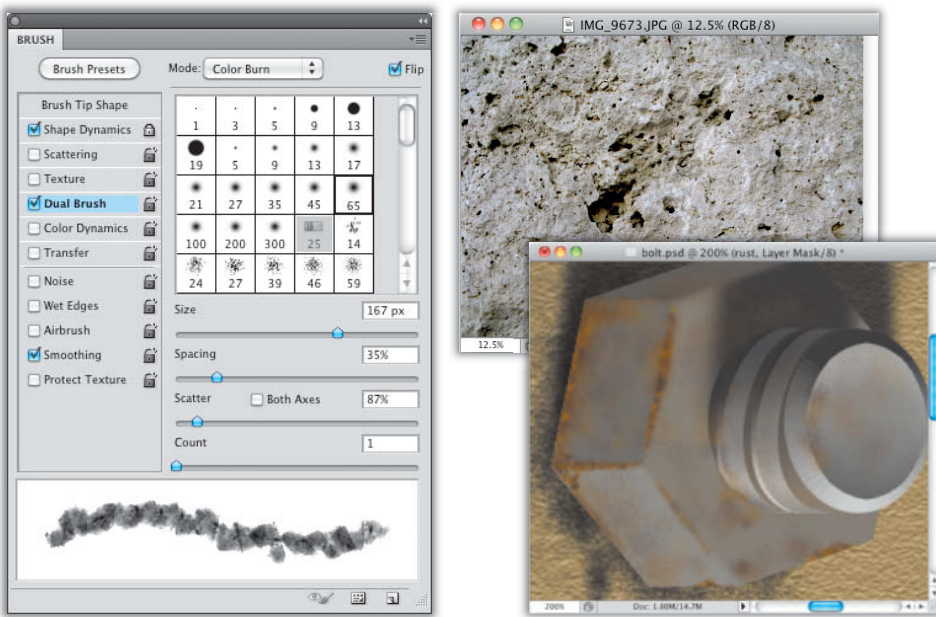
A photo of a rough stone was used to create a custom brush tip that was then used to create the illusion of dirt and rust in various places throughout the painting

tip paint at a different angle from all of its neighbors. Finally, I dialled the Foreground/Background Jitter setting all the way up to 100% in the Color Dynamics section.
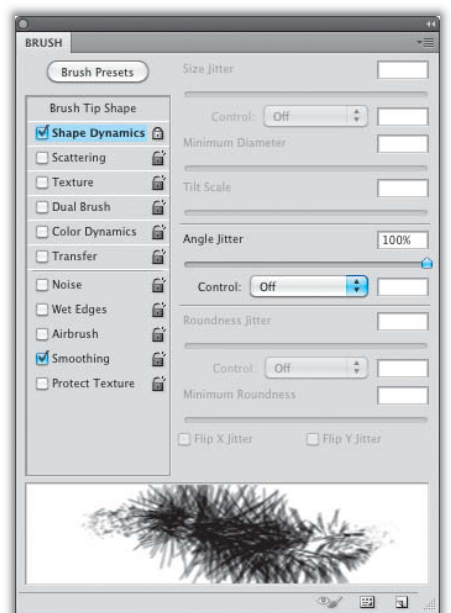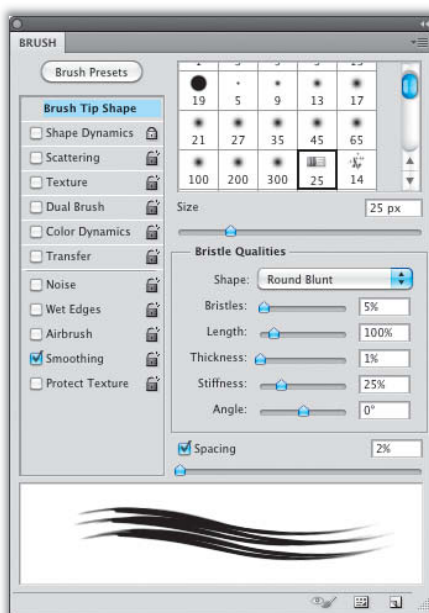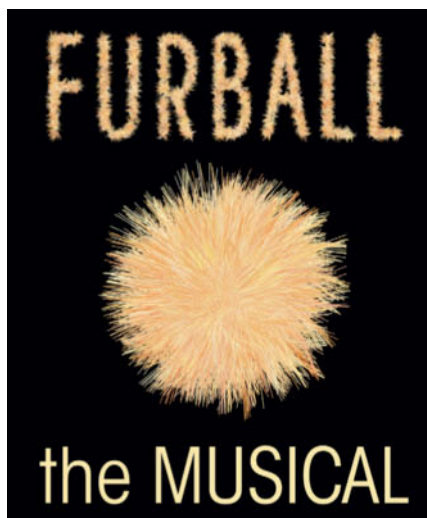
With the Paintbrush tool all set up, I chose orange for the foreground color and white for the background color and stroked the text path to give it its furry look. The Bristle Brush tool also allows me to create billboards that look as if they were painted using a thick, coarse brush.

The Window to the Soul

The hundreds of people who appear in the painting are all family, friends and associates. The methods use to create them would take up a whole separate article, so I will limit myself here to describing how I made the window to the soul -- the eyes. All of the shapes that make up the people's eyes were created using the Pen tool. The path for each element resides on its own layer and was filled with an appropriate color. I filled the shape for the white of the eyes using a light gray tone.

Locking the layer transparency to ensure that any alterations take place within the basic shape, I colored the edges with a dark pink tone using a soft-edged brush. I use the Burn tool to darken the white area at the edges of each eye using the Burn tool to give them a rounded look.

I filled the path for the iris on a new layer using a brown tone, and blurred the layer slightly (Filter > Blur > Gaussian Blur) to

transparency based on the value of the color used.

These effects really take advantage of graphics tablet technology and I used this feature to twirl the brush while painting, although holding a mouse in place and twirling it works just as well. I selected the resulting spot and saved it as a Brush Preset. I typed the text for the title ("FURBALL") and then chose Layer > Type > Create Work Path

to turn the text into a path. I selected the Paintbrush tool and used the newly created brush tip. I then increased the Spacing setting (in the Brushes panel) to make each tip appear separate while slightly touching its neighbor.

In the Shape Dynamics section of the panel, I set a high percentage value for Size Jitter and Minimum Diameter to prevent the tips from getting too small. I pushed the Angle Jitter setting all the way up, which made every

The furry typeface was created using a Bristle Brush and two colors: simply rotate the brush, select random Angle, Spacing and Thickness settings and use them to draw a path – that's all it takes!
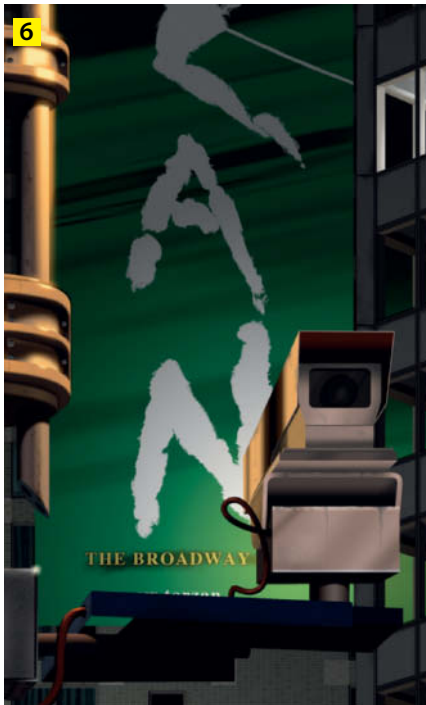
The Bristle Brush introduced with *Photoshop CS5* was also used to produce various posters that look as if they were painted using a thick, coarse brush

soften the edges. I then applied an Inner Glow Layer Style. Inner Glow is the only Layer Style that applies a color evenly along the entire edge of the contents of a layer. I wanted to darken the outer edges of the iris so it was necessary to alter the parameters of the Layer Style. I set the color to black and Blend Mode to Multiply. I then adjusted the Size value until I achieved the effect I was looking for. I darkened the top edge of the iris using the Burn tool, the same way as I did for the white of the eye.

I then clipped the layer containing the iris with the layer containing the white of the eye. This is done by clicking between the two layers in the Layers panel while pressing the Option key (or the Alt key in Windows). Clipping masked the iris so it can only be seen within the visible part of the eyeball.

Adding Texture

Next came the texture in the iris. Here, I selected a small square shape in a new layer above the layer containing the iris and filled it with black. I then applied the Add Noise filter (Filter > Noise > Add Noise) using a high Amount setting to produce a lot of noise.

To get the look of the texture extending outward from the center of the eye, I applied the Radial Blur filter (Filter > Blur > Radial Blur) with the Amount set to its maximum of 100 and the Blur Method set to Zoom. You can see the result in the illustration below.

The noise required more contrast to give it the right look, so I applied a Levels adjustment with both the black and white point sliders moved inward.

I then clipped this layer to the white of the eye too to mask the texture within the eye. I then selected the iris layer and created a Layer Mask for the radial blurred noise layer to limit the noise effect to the circular shape of the iris. I used Multiply mode for the radial blurred noise layer to allow only the dark tones to darken the brown of the iris. The overall brown color of the iris showed through the areas that are white in the noise layer. In a new layer, the path for the pupil of the eye was filled with black.

The final touch involved the addition of a a separate layer containing reflections that make the eye look moist. Here, I used the reflection of the billboard. It was not
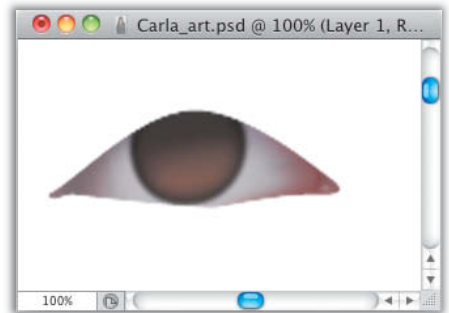
The eyes started out as filled paths that were gradually colored and darkened to give them substance

necessary to include much detail in the reflection as the viewer will imagine it from the context.

Photoshop makes it simple to create all the tiny details that help to make an image like this look real. The entire Times Square process was a learning experience that I would definitely repeat if the right subject comes along. (akr) **c't**
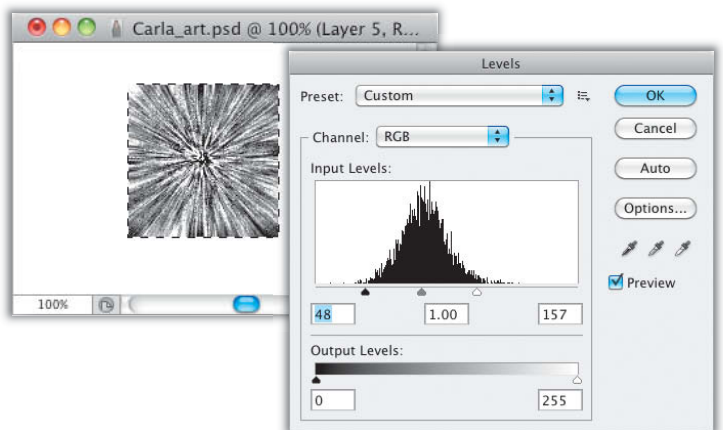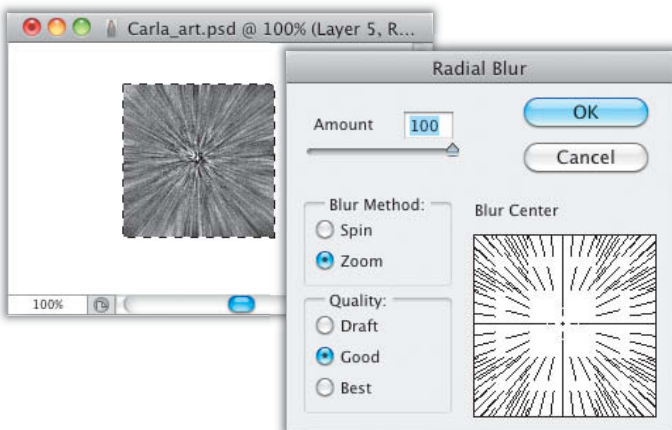
The texture in the iris was created using the Radial Blur tool, and contrast within the iris was increased using a custom Levels adjustment

Stefan Arand

How to Shoot
Gigapixel Images

An entry-level DSLR is usually good enough for shooting the countless source images that make up gigantic 'gigapixel' images with virtually unlimited resolution. Viewers can zoom right into every detail of an online gigapixel image and even the smallest sections can be printed in clear, sharp detail. This article shows you how to produce gigapixel images, reaching the limits of human and machine in the process. The rewards of all this effort are spectacular images that provide a unique, fresh way of looking at the world.

Free on DVD

This issue's free DVD includes a set of links detailing gigapixel service providers as well as sites where you can view selected gigapixel images and download specialized stitching software

Gigapixel Images

A gigapixel image consists by definition of at least 1,000 megapixels (i.e., one billion pixels). That is one hundred times the number in an image produced by a conventional 10-megapixel camera. One of the largest gigapixel images currently on display is an 80-gigapixel monster panorama of London (see http://www.360cities.net/london-photo-en.html). This type of image is produced using a combination of a special motor-driven panorama tripod head and conventional image stitching techniques.

Instead of the wide-angle or fisheye lenses you might use to shoot a conventional panorama in one or just a few shots, a gigapixel image uses a long lens (for example, a 200mm telephoto) to shoot a large number of images covering a multitude of very small sections (see the illustration below).

But that is almost too much of a good thing, as 11 megapixels of resolution are quite sufficient to produce a 1 × 0.5-meter canvas print at 120 dpi. Additionally, gigapixel images also allow you to make enlargements of any detail you choose, or canvas prints of up to 40 square meters in size and fine art prints with resolutions of up to 300 dpi. A 50,000 × 20,000-pixel image will measure 4.2 × 1.7 meters (14 × 5 ½ feet) at 300 dpi. The same image printed as an advertising hoarding at 30 dpi would be 42 meters long and 17 meters high!

But these kinds of print sizes are nothing more than a game of numbers for most users, and gigapixel images are much more commonly displayed online. Most of the serious gigapixel images currently available for online viewing are enormous panoramas that are perfect for in-depth exploration. However, panoramas aren't the only option, and gigapixel techniques are well suited to making spectaclar close-up and macro images too.

Once you have decided on a subject and selected an appropriate lens, the time-consuming work of actually shooting your images begins. The sheer amount of time involved in this type of shoot is reminiscent of hae early days of photography, with the basic setup taking perhaps a quarter of an hour while the shoot itself can take much longer. With the setup we used it took about an hour to shoot the 500 source images used in our five-gigapixel image. Basic development of the raw image material took 45 minutes, followed by another hour to perform the rough stitching. In other words, it was now more than three hours after we started before we could view the first usable results. Even at this point, the most laborious stages of the process – i.e., fine-tuning the stitching, post-processing and final retouching – are still ahead of us.

It is simply impossible to shoot gigapixel images quickly and spontaneously, but the large number of photographers (including myself) who display their hyper-detailed images on the Web shows just how popular this fascinating technique has become.
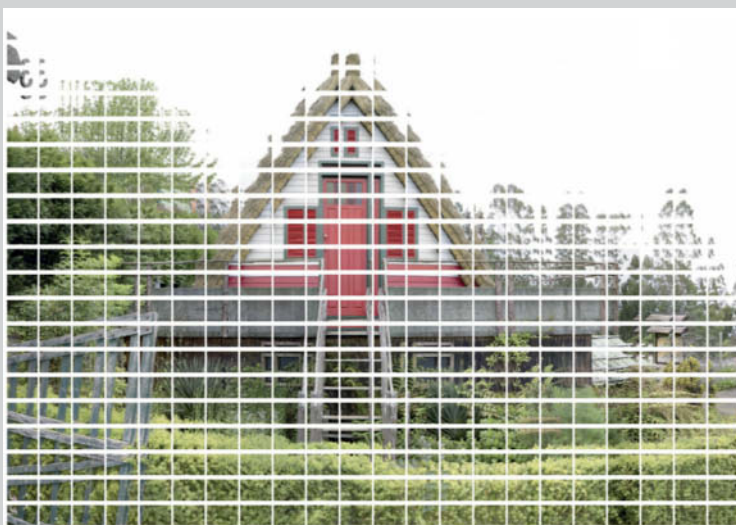
The focal length of the lens you use determines the number of individual source images you need to shoot to cover a certain angle of view. The image on the right was shot using a 21mm lens and consists of 12 separate source images. The resulting image is 0.08 gigapixels in size. The one on the left was shot using a 200mm lens and resulted in a 4.3-gigapixel image composed of 440 separate source images.

Types of Subjects

Nearly all gigapixel images displayed on the Web are completely sharp, which tends to make them look slightly flat and one-dimensional. Not only that, but many don't appear to have been post-processed. Our stated aim, which is also the aim of the project described in this article, is to produce gigapixel images that work as self-contained compositions as well as the source of unique detail enlargements.

Gigapixel Panoramas

Most people who are familiar with gigapixel images associate them with panorama views. Many popular gigapixel images are of cityscapes or large-scale public events and are created using motor-driven panorama heads and mass-stitching techniques. Many of these images givee the impression that their creators' aim was simply to produce an enormous image with scant regard for the artistic or aesthetic value of the results. Balanced tonal values and corrected stitching errors also appear to be low priorities for many gigapixel photographers.

Extreme resolution isn't the be-all and end-all of a gigapixel image, and you can make your images stand out from the crowd by concentrating on overall quality and the effect they have as well. Deliberately emphasizing individual elements of the foreground and the background increases the feeling of depth in a panoram, and monochrome and retro-style processing can give gigapixel images an impact that goes well beyond pure size.

The highly technical nature of gigapixel images makes it all too easy to forget about composition while shooting. It is always a good idea to make a test shot of your chosen subject using a wide-angle or fisheye lens in advance of the actual shoot. This way you can choose the best shooting angle and framing options in your own time before work begins in earnest. A compact camera is often sufficient for making test shots of a scene.

Middle-distance Gigapixel Subjects

Subjects at medium distances can produce gigapixel images that are just as spectacular as panoramas. A house shot at a distance of eight meters using a 200mm lens produces hundreds of source images and a unique-looking final image that is reminiscent of a large-format photo. The image on page 38 contained a large number of unsharp areas that made stitching particularly challenging. We used *PTGui Pro* to stitch the image and ended up setting more than 1,500 manual control points. The shallow depth of field caused by the long lens gives this type of image an almost macro look.

Gigapixel Macro Images

Shooting gigapixel images of macro subjects presents a very special challenge, but produces astonishing results with a completely new dimension of detail that allow the viewer to identify structures and correlations that are otherwise invisible. For example, the technique allows us to see the tiniest traces of the manufacturing process in the apparently smooth surface of a metal object, and makes it possible to combine close-up, macro and microscopic elements in a single image.

Producing finished gigapixel images requires extreme precision while shooting, processing and stitching. For the examples shown here we used a Canon EF 100mm f/2.8L Macro IS USM and the special Macro Photo MP-E 65mm f/2.8 1-5× manual focus lens, a fantastic optic that produces magnifications of up to 5:1. The EF lens has maximum magnification of 1:1. Generally, a lens described as 'macro' is capable of shooting at magnfiications of 1:4 and greater.

The complete lack of focusing aids and negligible depth of field that the MP-E's high magnifications produces made it extremely difficult to accurately calculate the nodal point for the various different reproduction scales. Even Canon itself cold not provide any further information when we asked. For more information on the importance and calculation of nodal points, see the article on panorama photography in Issue 4 of *c't Digital Photography*.

Fortunately, our GigaPan EPIC Pro robotic camera mount functions precisely enough to shoot source images with 30 percent overlap, even at 5× magnification. The resulting raw material is extremely difficult to stitch, as it consists of 90 percent unsharp detail and we didn't stack focus during the shoot (see our focus stacking workshop in Issue 5 for more details on artificially increasing macro depth of field). The only options left open to us were to set our control points manually or to use *GigaPan Stitch* – but we will go into more detail on this aspect of the project later.

Increasing or slightly reducing the viewing distance increases the perceived depth of field for the entire image.

California-based GIGAmacro (www.gigamacro.com) specializes in manufacturing gigapixel macro image capture systems which, in contrast to conventional panorama heads, scan the subject in two dimensions and use focus bracketing to optimize depth of field in the results.

This two-gigapixel image shows a ghost town in the south-east of the island of Madeira. It was shot using a Canon EOS 60D and a 70-200mm zoom set to 200mm and f10 mounted on a GigaPan EPIC Pro camera mount. The weather was slightly drizzly, providing us with soft light and a distinctive atmosphere that is rare in gigapixel images. A light towel provided makeshift protection for our gear during the shoot, which produced 298 source images over a period of 29 minutes.

Shooting Technique

Shooting gigapixel images requires a degree of precision not always offered by conventional panorama tripod heads. The GigaPan EPIC we use is accurate to within 0.04 degrees of pan. As a comparison, the click stops built into a US$100 Novoflex panorama head have 10-degree increments. It is possible to judge differences of down to about two degrees by eye. It is also important for all source images in a long sequence to be shot consistently and accurately. If one shot in 700 is blurred or missing, it can ruin the entire shoot.

The EPIC Pro was originally developed by NASA in cooperation with Carnegie Mellon University for use on Mars missions and has since been adapted for general commercial use. The US$895 device is designed for use with DSLR cameras – there is an overview of this and other, similar devices in the table on page 37.

The EPIC Pro itself weighs 3.3 kg (7.3 lb) and can support a maximum weight of 4.5 kg (10 lb). Combined with an extra battery, a solid tripod and a lens or two, a basic gigapixel setup can quickly end up weighing more than 15 kg (33 lb). To avoid making unnecessary treks laden down with heavy equipment, it is important to consider exactly which subject you want to shoot and why before setting out, otherwise you will .

Because the probability of producing stitching errors in images constructed of hundreds of source images is relatively high, subjects with many moving elements are not suitable for the gigapixel approach. If possible, choose a subject that you can capture under consistent lighting conditions – otherwise you are likely to finish up with ugly specks in your image that are difficult or impossible to remove at the post-processing stage. Don't let your source images overlap too much, as many stitching programs cannot handle large overlaps and too much overlap will generate enormous amounts of superfluous raw material that you will have to discard later. The sample images shown in this article are constructed from between 290 and 725 individual source images. Usually, 25 to 30 percent overlap is sufficient.

A 32 GB memory card can store approximately 1,300 RAW images shot using our Canon EOS 60D. This should be enough for most gigapixel shoots, but do make sure that you have enough spare memory to cover the entire shoot before you start. A specialized head like the EPIC Pro doesn't register full memory cards and simply continues to execute the programmed sequence regardless of whether or not the camera is actually recording anything.

The final size and the look and feel of a gigapixel image are determined by the focal length of the lens you use. Generally, the longer the lens and the broader the angle of view, the more pixels the finished image will have. A 180 × 90-degree panorama shot using a crop-format camera and a 21mm lens set to f10 will result in an image with about 0.4 gigapixels and good overall sharpness at medium subject distances and above. The same angle of view shot using a 200mm lens set to f10 will produce an image with about 20 gigapixels and very shallow depth of field.

The GigaPan EPIC Pro programmable camera mount supports up to 4.5 kg (10 lb) and is shown here with our Canon EOS 60D with a 70-200mm f/2.8 zoom attached. The RRP for this fine piece of gear is US$895.
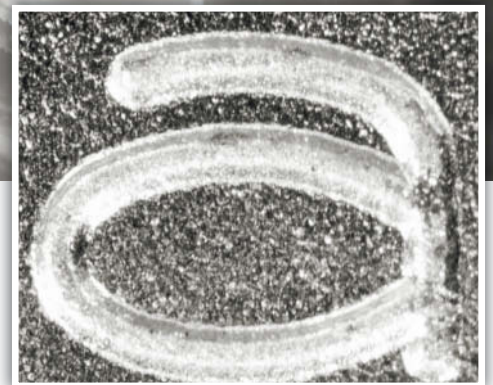
This 1.4-gigapixel image of a vintage camera was constructed from 290 source images shot using a Canon EOS 60D, an EF 100mm f/2.8 macro lens and, once again, our trusty GigaPan EPIC Pro. The magnified detail shot reveals deven the tiniest signs of use and traces of the metalworking techniques used during the camera's manufacture.

Floods of Data

A gigapixel shoot produces a large number of very large data files, making a large amount of high-speed disk space a must. A 200GB project folder containing 50,000 source images is not unusual in gigapixel territory. This type of project also tests the limits of many common image file formats. For instance, a JPG image has a maximum width (and height) of 30,000 pixels, making 0.9 gigapixels (approximately 800MB) the maximum possible size of a stitched JPG image.

Adobe's PSD (Photoshop Document) format supports a maximum file size of 2GB, while TIF files can be as large as 4GB. The Photoshop RAW and Photoshop Big File (PSB) formats support maximum image dimensions of $300,000 \times 300,000$ pixels, giving us a maximum workable image size of 90 gigapixels. However, Photoshop RAW is not suitable for post-processing gigapixel images because it doesn't support layers. What all this boils down to is that PSB is the only file format available at present that meets all our needs.

Relatively small amounts of post-processing can quickly produce PSB files of

60GB and more, making file splitting or using a hard disk the only practical backup solutions.

Hardware

As mentioned, we used a Canon EOS 60D with various lenses, a heavy tripod and the GigaPan EPIC Pro to shoot the sample images shown here. The EPIC Pro has to be set up to support the particular camera/lens combination you are using and programmed with appropriate focal length, image area and shooting interval data before you start

Shooting this 2.3-gigapixel image was a real challenge. We had to transport more than 30 kg (66 lb) of equipment up a muddy hill, where wind and rain set in the moment we arrived. Our GigaPan EPIC Pro and Canon EOS 60D/EF 70-200mm f/2.8L IS II USM spent 28 minutes under an umbrella recording 318 source images (200mm at f11 and ISO 800, active image stabilizer).

This spectacular gigapixel image was made from 290 source images shot using the Canon MP-E 65mm macro lens. At 3× magnification and f11, depth of field is minimal, but can be inceased by lengthening the viewing distance or reducing the size of the two-gigapixel image. We stitched this image using *PTGui Pro*.

Motor-driven Panorama Heads

Product	EPIC	EPIC Pro	Merlin	Panogear	Rodeon VR Head CL	Rodeon VR Head HD	Roundshot VR Drive full
Manufacturer	GigaPan	GigaPan	Teleskop Austria	Kolor	Clauss	Clauss	Seitz
URL	www.gigapansystems.com	www.gigapansystems.com	www.teleskop-austria.at	www.kolor.com	www.dr-clauss.de	www.dr-clauss.de	www.roundshot.ch
Features	Panorama head	Panorama head, battery, charger, AC adapter, various camera connection cables, Manfrotto camera adapter	Manually controlled panorama head, battery holder	Merlin panorama head, straight rail, L-bracket, batteries, charger, various camera connection cables	Electronically controlled panorama head, batteries, charger, Manfrotto camera adapter	Electronically controlled panorama head, batteries, charger, Manfrotto camera adapter	X and Y motors with touch screen control, VR bracket with Q-Mount, battery, charger, remote release cable
Weight	1.4 kg (3 lb)	3.3 kg (7.3 lb)	1.8 kg (4 lb)	1.8 kg (4 lb)	3 kg (6.6 lb)	5.7 kg (12.5 lb)	2.7 kg (6 lb)
Control system	Fully programmable panorama head for compact cameras. Control system requires no additional equipment.	Fully programmable panorama head for DSLR cameras. Control system requires no additional equipment.	Built-in manual control. Remote control via Bluetooth and notebook or PDA (adapter costs approx. US$135 extra)	Bluetooth and manual control built in. Programmable handheld controller with touch screen available for US$400 extra.	PDA or Notebook via Bluetooth, USB or serial connection	PDA or Notebook via Bluetooth, USB or serial connection	Built-in
Details	Compatible with many compact cameras. U-shaped. GigaPan Stitch software included but only really good for preview stitching. GigaPan runs its own server for online gigapixel image upload and display.	Compatible with most DSLRs. Fast. Supports up to 4.5 kg (10 lb). GigaPan Stitch software included but only really good for preview stitching. GigaPan runs its own server for online gigapixel image upload and display.	Accessories only available separately: L-bracket US$70, EOS connection cable from US$15. Some DSLRs cannot be positioned accurately at the nodal point.	Complete system, compatible with various camera types. Handheld controller available separately for US$300. Some DSLRs cannot be positioned accurately at the nodal point.	L-shaped for most DSLRs. High-end construction, very fast.	U-shaped for even heavy cameras. High-end construction, very fast.	Combination of two separate motors with the conventional Novoflex VR system
Price (approx. in US$)	299	895	220	820	5,500	9,500	from 3,000

to shoot. The device's motor has three speed settings, and we recommend that you use the slowest if you are using a heavy lens or shooting in macro situations, as this prevents vibrations caused by the camera's movements from blurring the captured images.

We invested in some high-end post-processing hardware: a PC with an Intel Core i7-2600K processor clocked at 3.4 GHz, 16 GB of RAM, a 3 TB RAID 0 hard disk and two additional RAID 0 250 GB SSDs for our swap files, plus three 24-inch monitors to give ourselves the best possible overview of our stitched images.

But even our sophisticated setup quickly reached its limits when processing gigapixel images. Opening a 4.8-gigapixel image in *Photoshop* quickly shows that even 16 GB of RAM aren't sufficient, as *Photoshop* begins to create huge temporary files on its scratch disk after just a few seconds. If you don't radically reduce the number of history states in the program's preferences, a 500 GB disk will quickly fill up with 64 GB temporary files.

Our SSDs are much faster than our RAID hard disks and, although the read/write speeds of both RAID setups are pretty well identical, using SSDs significantly increased the speed of our *Photoshop* and *PTGui*-based workflow.

Post-processing in *Photoshop* was by far the greatest challenge for our hardware, while RAW development and stitching did not present any major problems.

Software Requirements

We developed our RAW source images using *Lightroom*. In order to give ourselves the maximum possible processing headroom, we decided to extract 16-bit TIFs from our RAW data files. To give us an impression of the effect our develop settings would have on the stitched image, we then produced a series of 800 × 600-pixel, neutrally-developed JPGs which we stitched together using *GigaPan Stitch* (included with the EPIC hardware or available for US$9.99 online). The software is fully automatic, which has advantages and disadvantages.

GigPan Stitch stitches source images together in the order in which they were shot, which prevents you from having to set large numbers of manual control points for images that contain significant areas of unsharpness. The software is extremely capable, but would be much faster if it was multi-core compatible. During stitching, *GigaPan Stitch* creates a new sub-folder that contains all of the individual partial image files that are required when uploading such enormous images to the Web. As a result, the sub-folder can contain several tens of thousands of files.

After re-importing our roughly stitched image to *Lightroom* to make our detailed develop settings, we saved and applied them to the individual RAW source images. We were then able to export the resulting 100 MB TIFs for final stitching.

We used *PTGui Pro* for stitching. Once the program's automatic control point search was completed, we were often left with a number of non-allocated source images, especially for subjects with shallow overal depth of field. Non-allocated images have to be inserted into the stitched image by hand, which can be fiddly and time-consuming. On the other hand, *PTGui* had no problems stitching conventional panorama images fully automatically.

Once all the control points have been set, it is quite simple to correct stitching errors, especially for raw material that has been shot very precisely. It is usually possible to export images aligned by *PTGui* as PSB layer files and to blend them together in *Photoshop*. This procedure is relatively easy to master for images with 50 or 60 layers, but even *Photoshop* can't cope with the several hundred layers that make up a raw gigapixel image, so we exported our stitched image from *PTGui* to a single-layer PSB image, which we then opened in *Photoshop* for post-processing.

The software we used

Adobe Lightroom 3.4	US$250
GigaPan Stitch 1.0.0805	US$9.99
PTGui Pro 9.0.4	US$200
Adobe Photoshop CS5	US$700

We shot this image from about eight meters away using our 70-200mm zoom set to 200mm and f10. The long lens and relatively short subject distance give the finished image a macro look and feel. Constructed from 440 source images, it is 4.3 gigapixels in size. The blurred portions of the foreground forced us to set more than 1,500 manual control points using *PTGui Pro*. This and other gigapixel images are available for online viewing at the URLs listed on this issue's free DVD

Post-processing

Post-processing gigapixel images involves several distinct steps. The first step is to correct obvious stitching errors. This is best done during stitching (in our case using *PTGui Pro*), as subsequent retouching in *Photoshop* is usually a lot more complex and time-consuming. You need patience, a good eye and help from others to find the largest possible number of stitching errors. Working alone is never the best way to ensure complete accuracy when you are working with such large images.

If individual source images are blurred or too noisy you can always make them smaller to increase perceived sharpness. The enormous resolution of the complete image makes this a less risky approach than it would be for a conventional image and makes it possible to rescue a gigapixel image with only a slight loss of overall resolution.

We used *Photoshop CS5* to perform our final fine-tuning. Remember to reduce the number of history states to a minimum before you start processing, otherwise you run the risk of exhausting your scratch disk capacity before you have finished the job.

Processing gigapixel images exposes a number of software limitations that conventional projects don't reveal.

Even the largest, 2,500-pixel brush tips are too small for effective use with gigapixel images. This size of tip is simply too narrow to paint an effective gradient in a Curves layer, and the same is true of all tools that change the effect of selections, such as Gaussian and most other blur commands.

We worked around this problem by reducing the size of the image to a width of 20,000 pixels, creating the gradient with a suitable brush tip and then re-scaling the retouched layer mask to its original size before importing it into the original file. In other words, we scaled only the gradient layer, not the entire image. In the end, it took about 10 minutes to paint the gradient.

One of the most significant problems created by processing large images in *Photoshop* is the swap file, which has to give the program access to virtually all image data for every action you make. Only a tiny portion of a complete gigapixel image can be stored in main memory, so fast, high-end swap media are essential for post-processing work.

Opening and saving multi-layer *Photoshop* images takes a lot of time – our images took as much as 50 minutes to save or load. This trains you to think hard before saving individual processing steps, and the reduced number of undo steps available when processing large files forces you to work carefully and accurately. Reliable hardware that doesn't threaten to pack up during a long save routine is also essential for this type of work.

If you crave even more complexity, you can also shoot HDR gigapixel images using bracketing sequences for your source images, or macro gigapixel images with focus-stacked source material. But be warned: HDR gigapixel images tend to become generation-spanning projects!

The Finished Gigapixel Image

You can export a finished gigapixel image directly from *Photoshop CS5* and upload it to your website using *Zoomify*, which has been built into the program since its CS3 iteration. Once it is online, a gigapixel image can be viewed using simple hardware and the *Flash* plug-in. For other ways of viewing gigapixel images, see the following article on page 42. Large-scale fine art prints and extreme detail enlargements are two further exciting ways to present this type of image.

Gigapixel photography is not a pastime for the impatient. You have to be a little crazy to get to grips with this type of project, and the result can be several weeks of social isolation! Gigapixel images test many limits, whether those of your hardware, your software or your personal budget of time and concentration, but the results can be breath-taking and offer a truly unusual view of the world. And, if you follow our tips, your next gigapixel image is sure to end up being one of the better ones on display on the Web. (jr) **c't**

Sample image workflow

Camera setup	15 min.
Shooting	60 min.
Image data transfer	25 min.
Develop preview and export using *Lightroom*	45 min.
Preview stitching using *GigaPan Stitch*	35 min.
Final 16-bit TIF development using *Lightroom*	55 min.
Automatic control point search using *PTGui*	15 min.
Stitching error search	4 hours
Set manual control points	5 hours
Export complete 16-bit image	1 hour
Photoshop post-processing	15 hours
Total	**29 hours**

These figures apply to the image printed on pages 38 and 39

This image illustrates the full potential of the gigapixel format. It is possible to zoom right into even the tiniest image areas to reveal fascinating details. The detail reproduced here shows the extreme level of detail in the finished image. Images like this allow the viewer to make countless crops and large-scale enlargements that make impressive images in their own right.

Ralph Altmann

Presenting and Displaying
Gigapixel Images

Gigapixel images cannot be displayed on the Web at their native resolution – the sheer amount of data they contain is too large. Specialized software and a few clever tricks are required to simplify online navigation and zooming. This article explains how to prepare your own gigapixel images for presentation online and introduces a number of online services that do the hard work for you.

The largest online image that we know about is 1,166 gigapixels in size – in other words, more than a terapixel. The image is not, in fact, a photograph, but rather a computer simulation of the cosmic structure of the universe 1.3 billion years after the Big Bang.

Such an image – and much smaller ones too – cannot be viewed on conventional monitors or on the Internet, as even the smallest gigapixel images contain as much data as 100 images captured by an everyday digital compact. Each pixel requires four bytes of data to be displayed at today's standard 32-bit color depth, which means that a one-gigapixel image requires 4 GB of RAM if it is to be completely loaded into a computer's main memory, and this is more than a standard 32-bit Windows system can support. This in turn means that some of the image data has to be loaded into the computer's swap file, which is usually located on much slower hard disk media.

Before you can even begin to load an image for viewing you have to download it from the Internet. Even at medium or high compression rates, most gigapixel images consist of multiple megabytes of data that load intolerably slowly on all but the fastest V-DSL connections. An even greater obstacle to gigapixel enjoyment is the fact that the JPG file format limits the height and width of saved images to 30,000 pixels. None of the gigapixel-compatible formats currently available can be compressed as effectively as JPG.

The solution is to split the single large image file into fragments (called 'tiles') and have the browser reassemble them as required – this way, the computer only has to load the section of the image currently being viewed. In order to prevent too many tiles being produced for large magnifications, it is standard practice to produce a number of copies of a gigapixel image with differing resolutions that are then individually tiled. For example, a 1.25-gigapixel image that measures $50,000 \times 25,000$ pixels will give us 196×98 (= 19,208) tiles if each tile measures 256×256 pixels (a common size). Each of these is then saved as an individual JPG file. The next (lower) resolution level will result in 4,802 tiles, followed by 1225, 325, 91, 28 etc. Halving resolution reduces the number of pixels in the resulting image and the number of tiles required to reconstruct it by a factor of four, and removes any limits to the size of the images you can process and upload.

The relative positions of the tiles that make up a gigapixel image are stored in an HTML table or a separate XML file. Zooming or panning/tilting within an image is implemented using JavaScript, Flash or proprietary browser plug-ins such as *Silverlight* or *HD View*. We will discuss how to use these tools later on. A simpler solution is to use Web services that do the donkey work for you – all you have to do is upload your source images and set a few parameters. The following sections take a closer look at the ins and outs of using this type of service.

GigaPans for Everyone

The gigapan.org website makes presenting gigapixel images extremely simple. All you have to do is create a free account, download the site's special upload software (available for Windows and Intel Mac) and select the image you wish to display. Then you just have to wait until the software has converted and uploaded your image. There are no limitations to the images you can share, and many of the images available for viewing at the site are smaller than one gigapixel. In addition to the common JPG, TIF and PNG formats, the site also supports PSD and PSB files and various proprietary formats including Autopano KRO. Images are not pre-selected or edited and the range on offer includes town and country panoramas as well as a number of highly impressive macro panoramas of insects and the like. Various information, such as a title, image data and a comprehensive description can be added and edited later. The JPG tiles

At gigapan.org you can navigate all around the stored images, while the snapshots displayed beneath the main image indicate image elements that the photographer or others found interesting. Registered users can write comments and descriptions and upload Google Earth links to their favorite locations.

Microsoft's *ICE* panorama software can export finished panoramas to *Photoshop* formats (including layers) and can also automatically generate a JPG tileset for embedding in a website, whereas publishing at photosynth.net (which is only possible using *ICE*) only allows you to upload uncropped, full-resolution images

are displayed using Flash, and zooms and pans are smooth and easy to control using either your mouse or the on-screen menu. The site zooms automatically to the center of the displayed image. If an image has been geotagged – which is easy to do using Google Maps and a browser – you can embed it in Google Earth using its associated downloadable KML file.

Registered users are welcome to explore all the images that reside at gigapan.org, and can leave comments or save details and crops as snapshots on their own computers. The popularity of the images on display is ranked using the 'Explore Score' and you can sort them according to popularity or age, or filter them for tags. There is also a general search box and an 'Easter egg' fun feature. If you switch your uploaded images to private mode, other users need to know their specific URL to view them.

The site's sharing features include a simple additional piece of HTML code that you include in your own site's code to allow you to embed private and public images in your website. This way, you can embed a complete image and up to 10 snapshots in an iFrame. You can adjust the size of the iFrame, but not that of the content, as this is transferred directly from gigapan.org. This approach means that the image itself does not take up any extra disk capacity at your website. You can, of course, also embed other people's images with their permission. The site also includes more complex script-controlled embedding methods, but we will leave you to explore those for yourself.

Photo Synthesis?

Photosynth started life as part of Microsoft's Bing Maps service and was designed for generating 3D panoramas. The resulting images, or 'synths', are constructed from multiple overlapping source images in a similar way to 2D panoramas. The major difference between the two formats is that the shooting position for a synth image is variable,
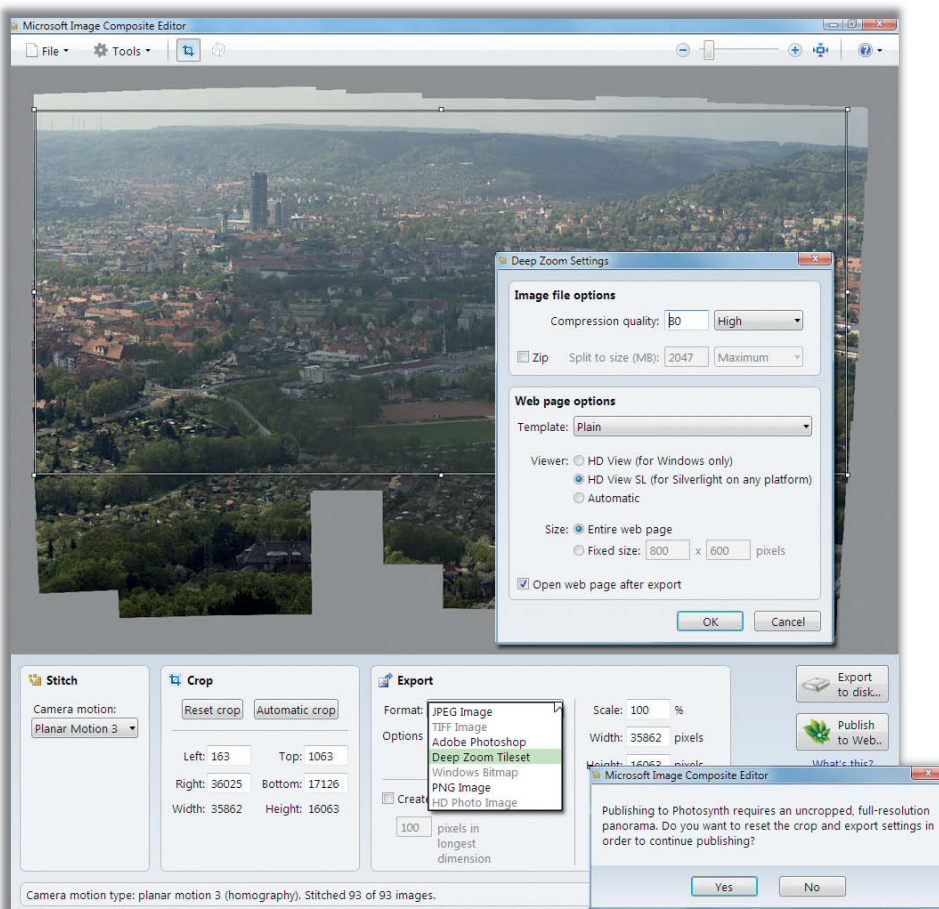
and the aim of the process is to shoot the source images from as many different angles, distances and perspectives as possible, including from behind. *Photosynth* then creates a three-dimensional puzzle that you can explore using your mouse. Every time you pan or move within a synth, the software displays the appropriate views. The jumps and steps between views can be quite erratic, depending on the number and quality of the source images available. Some of the many synths available for viewing at Bing Maps are constructed from many hundreds of individual photos.

Photosynth and Bing Maps are also capable of displaying conventional panoramas right up to gigapixel size. In fact, there are more panoramas than synths in the list of recent favorites at the site. As at gigapan.org, no-one edits or preselects the images on offer and we found even more uncropped or blurred images than at gigapan.org, as well as a lot that contain obvious stitching errors. We assume that a lot of people upload any old image to test the service, which requires you to register for a (free) Windows Live ID. There is no direct ranking feature, but users can mark images as favorites and leave comments.

Only the image author can generate snapshots. Images can be geotagged to a chosen location on a Bing Map. Generally, geotagged photos are available as a map location within a few hours. Here too, you can have the site generate a piece of HTML code for embedding your synths and other uploaded images on a website. Displaying images stored at photosynth.net requires the Microsoft *Silverlight* browser plug-in, which is not available for non-Intel Macs.

Apart from this one limitation, photosynth.net is just as easy to use as gigapan.org. In fact, we preferred the photosynth.net site layout and image navigation software, which zooms into the current cursor position rather than the center of the image the way gigapan.org does. The only real drawback at photosynth.net is its upload feature, which requires Microsoft *Image Composite Editor* (*ICE*), an almost completely automatic panorama program that controls the entire workflow, from source image selection to uploading the stitched panorama, without offering the user any opportunity to intervene. This 'all or nothing' approach means that you can neither upload images stitched using other software nor process or edit the finished *ICE* panorama. To
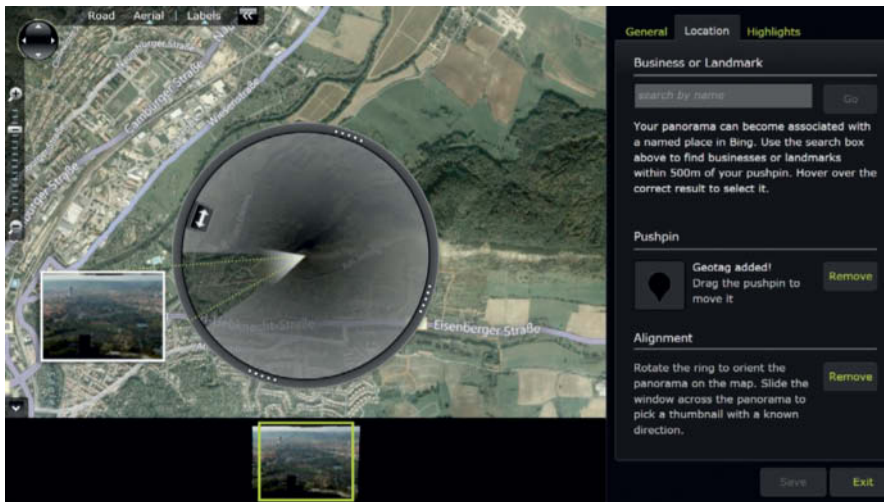
Setting the viewpoint and direction of view for a *Photosynth* Panorama is easy and intuitive

This equates to a maximum (non-compressable) TIF file size of about 4 GB, which then has to be uploaded using whatever Internet connection you have to hand. Equivalent JPG images are usually not much more than 1 GB in size.

In spite of these limitations, 360cities currently hosts some of the most spectacular gigapixel panoramas we have seen, including an 18-gigapixel view of Prague and an 80-gigapixel (!) view of London. It also hosts the world's largest currently available interactive interior panorama of the Strahov Library in Prague (40 gigapixels). These images prove that the display technology is available and functional, so it can only be a matter of time before the site's operators implement gigapixel upload functionality for members.

Various blog entries support this conjecture, but, until the feature goes live, members are restricted to uploading two

be honest, these limitations are obvious in some of the results published at the site. We can't see any reason why *ICE*'s built-in crop feature has to be deactivated before uploading an image. So remember, uncropped panoramas displayed at photosynth.net are not due to sloppiness on the part of users, but rather to the inexplicable inadequacies of the Microsoft software. This is a real shortcoming and spoils an otherwise attractive and fun-to-use site.

All-round Views

360cities.net is based in Prague and claims to be the largest community in the world dedicated exclusively to 360-degree panorama photos (i.e., images which include the zenith and nadir of the photographed scene). The site's publishers check all uploaded images for quality and originality and only the best are selected for display. In addition to the free standard account, there

are also Plus, Pro and Company accounts available for an annual fee of €49, €179 or €360 per year. A Plus account allows you to upload four images at a time for publication and any others that are not good enough for publication into your personal portfolio. Other users who know the URLs can view these images too, but they don't appear on the public website or in search results. The cost of membership and the publishers' selection criteria ensure that all the images on view are of consistently high quality.

360cities doesn't yet support gigapixel images, and upload is restricted to complete panoramas in JPG or TIF format. There is no software available for splitting panoramas into tiles prior to upload. Spherical panoramas, with their 360-degree lateral and 180-degree vertical views, always have a 2:1 image format. Combined with the 30,000-pixel maximum width supported by the JPG format, this restricts the maximum size of uploadable images to 450 megapixels.

A 360-degree spherical panorama is the best way to display the grandeur of museum interiors in a single image, as demonstrated by this 40-gigapixel panorama of the Strahov Library in Prague.
You can view this and other gigapixel images at the URLs listed on this issue's free DVD.
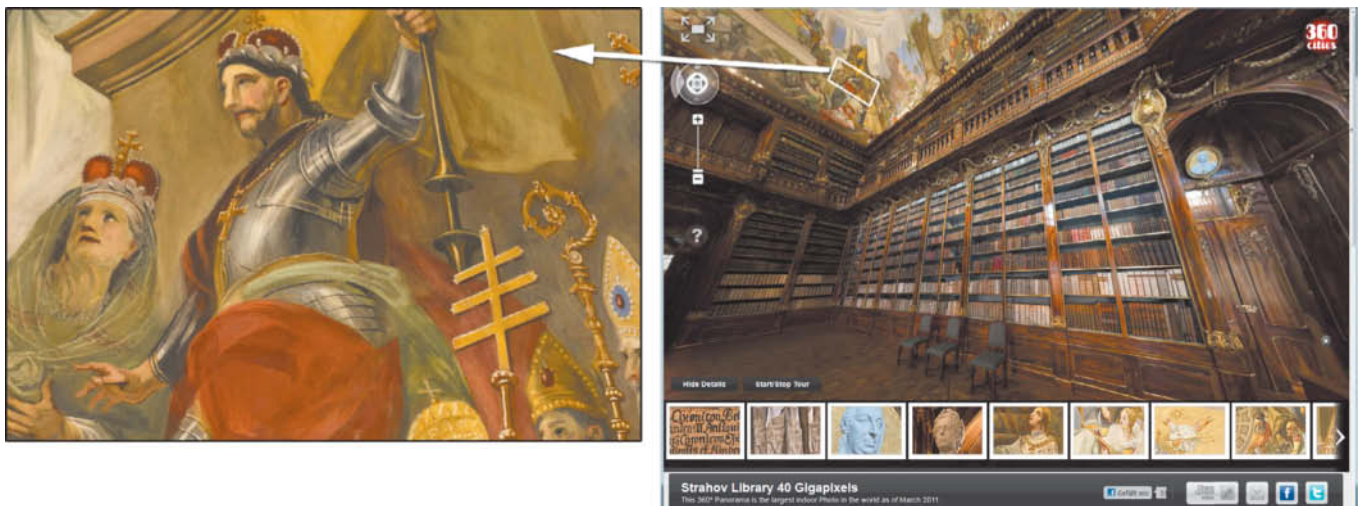
These four basic elements are the minimum requirement for displaying large images on the Web: a folder that contains the tile pyramid, the HTML Web pages themselves, an XML parameters file and your viewer of choice – in this case the SWF Flash application
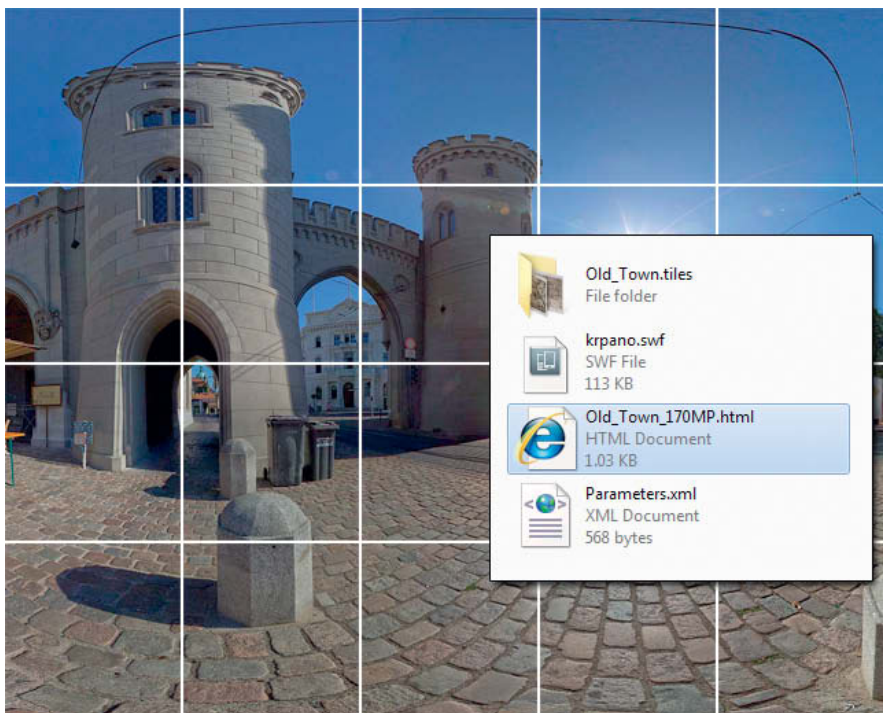
gigapixels of data at a time. This is rather limiting, especially in view of the fact that many spherical panoramas include large areas of sky, which in turn limits the degree to which the viewer can zoom into other, more interesting details. With a high-end camera such as the Canon EOS 5D Mark II, even using a lens with a focal length of 65 mm produces images that exceed the two-gigapixel image size limit, and most gigapixel photographers usually use much longer lenses than that.

Not all 360cities members are allowed unrestricted access to snapshot and comment functionality, but HTML code is available for embedding images in third-party websites. Images can be linked to others using arrow hotspots, giving you the opportunity to set up complete virtual tours. All images are linked to the Google Maps search function and selected images appear in the default Google Earth Photo Layer. Images that are accepted for publication can also be sold or licensed for third-party use via the website. The technical side of the viewing application is implemented using the *krpano Flash Panorama Viewer*, which we will describe in detail later on. Image navigation is smooth but takes some getting used to, as mouse movements don't shift the image itself (as they do in Map mode), but rather alter your angle of view, causing the image to move in the opposite direction to your mouse movement (QTVR Mode). Like gigapan.org, 360cities zooms to the center of the current image.

Hosting Your Own Gigapixel Images

The three services we have described all use readily available software, most of which is free. There is also a wide range of tools available that save you effort and simplify the process of preparing and uploading images without having to use a third-party service. This gives you more flexibility when deciding how to present your images, and doing it yourself means that your images won't contain third-party logos and allows you to configure your navigation parameters exactly as you wish. The downside to this approach is that it requires much more provider disk space and a lot more effort on your part. Again, there are various preconfigured software packages available that take the donkey work out of preparing your website for presentation.

The following sections assume that you are working with a finished JPG, TIF or PSB image (see also the previous article *How to Shoot Gigapixel Images*). First, convert your image to 8-bit color depth and, for safety's sake, to the sRGB color space, as most conversion software doesn't do this automatically. You should perform the same steps before you upload images to a service provider too.

Once you have prepared your images, you will need to perform the following steps:
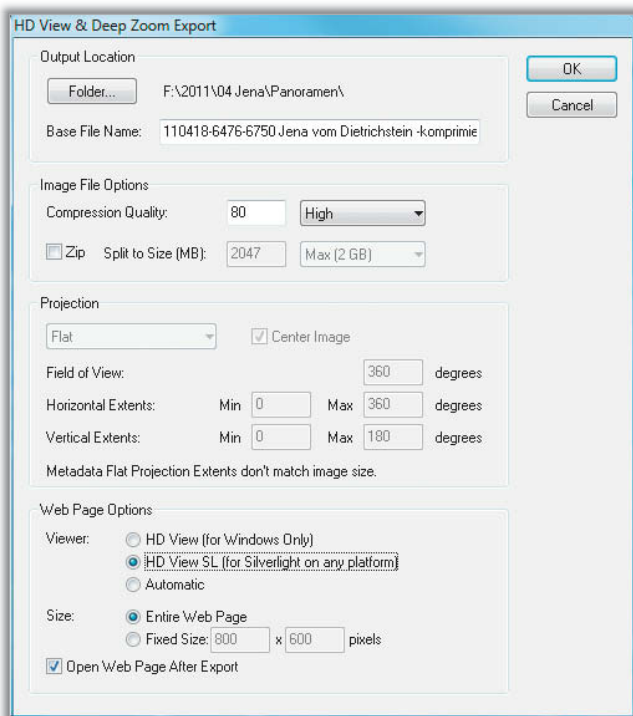1. Split the image into a pyramid set of JPG tiles.

2. Embed the tile pyramid and the appropriate viewer in your chosen website, and remember to include your desired navigation and viewing methods.
3. Fine-tune the finished website.

There are various software packages and browser plug-ins available to help you execute steps 1 and 2, which can be quite complex. No-one has to write HTML code for this type of work if they don't want to. Adobe *Flash* or Microsoft *Silverlight* are the current plug-ins of choice for image display.

Deep Zoom and HD View

Deep Zoom is the name Microsoft has given the *Silverlight* functionality that loads and displays only the parts of an image that the user has currently selected. You can produce the appropriate pyramid tileset using the free *Deep Zoom Composer* package, which supports JPG, TIF, PNG and BMP, but not PSB. In spite of this restriction, the program is usable for files that remain within the TIF file size limit of 4 GB, even if it is rather clunky and automatically creates a folder full of superfluous copies of all the source images you import. The program's highlights include the ability to create hotspots that can be directly linked to the original (or other) images.

However, Deep Zoom technology is also built into other applications that are better suited to our purposes. We have already mentioned Microsoft's *ICE* (see the

These *HD View* export settings automatically generate a finished Web page for viewing an image of any size

illustration on page 44), which not only has an export option that generates a Deep Zoom tileset but also automatically generates the appropriate HTML Web page code (step 2 in our list). Combining these two steps makes sense,as the tile pyramid has to match the viewer plug-in you are using. Unfortunately, *ICE* cannot read any finished panorama formats – it is purely a stitching package with only very basic image processing functionality. If you have access to *Photoshop* or *Photoshop Elements*, we recommend that you use these together with the Microsoft *HD View* plug-in, which has exactly the same functionality as the *ICE* Deep Zoom export option. The plug-in is part of the *HD View Utilities* package that can be found at the Microsoft Research website.

Once you have installed the appropriate 32-bit or 64-bit version of the program, the program folder will contain a plug-in with the .8be file extension, which you then have to copy to the *Photoshop* (or *Elements*) plug-ins folder. Once you have restarted *Photoshop*, the file menu includes the option *HD View & Deep Zoom* in the Export command, which exports the currently open image. Before export, you also have to select the target folder, your desired image quality and either a specific window size or the *Entire Web Page* option.

Select either the *100%* or *lossless* image quality option. This produces higher-quality PNG image files instead of JPGs, although these require more disk space than JPGs saved at 99% quality.

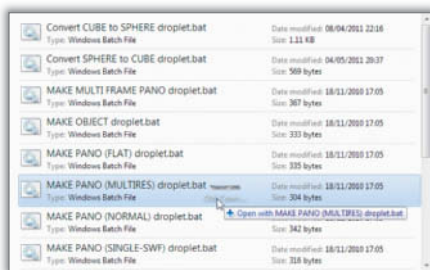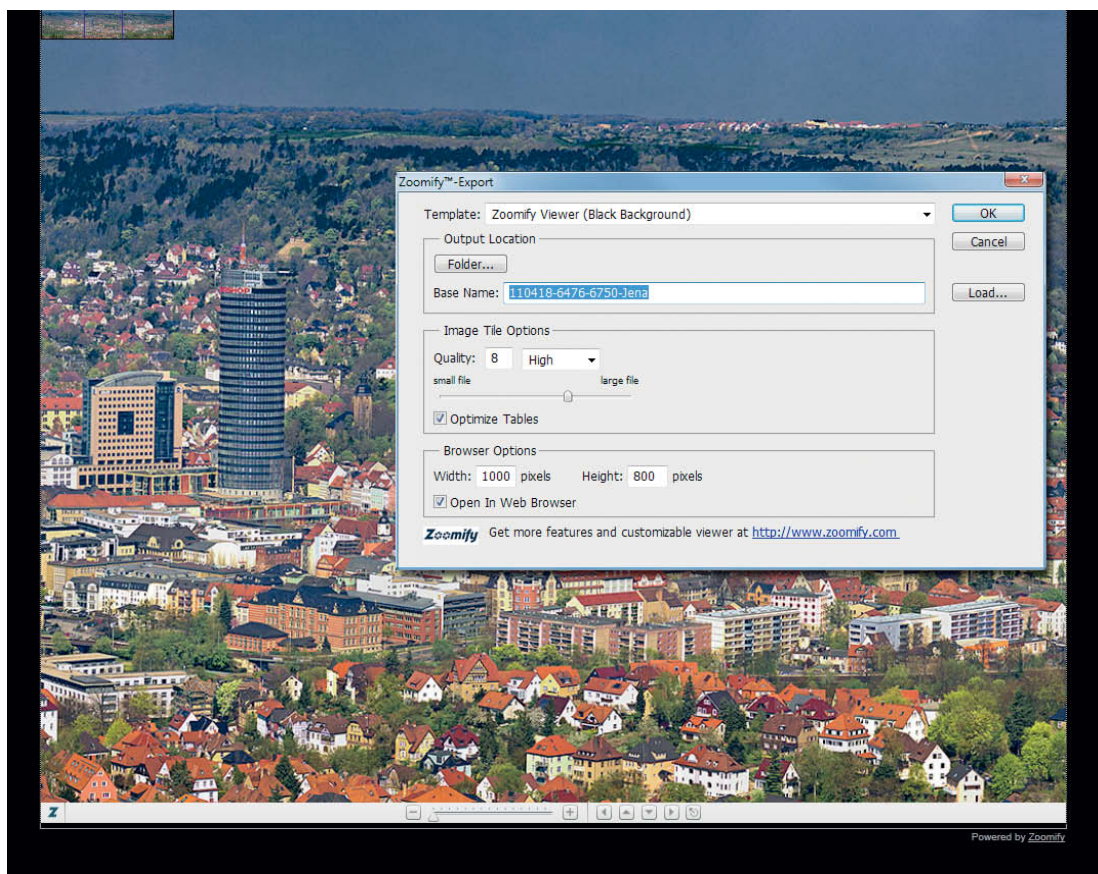The Viewer section in the dialog offers three options:

HD View (for Windows only) produces results that are, as the name suggests, neither Mac nor Linux-compatible, but which offer a choice of various projection types. *Flat* is good for panoramas that do not cover a 360-degree scene. *Cylindrical* is used for subjects that form a full circle (either horizontally or vertically), and the *Spherical* option is self-explanatory.

HD View SL (for Silverlight on any platform) utilizes the Deep Zoom functionality built into the *Silverlight* browser plug-in, which is compatible only with Windows PCs or Intel Macs – in other words, the suffix "on any platform" isn't really true. A Linux variant of the software called *Moonlight* does exist, but wasn't available for testing at the time of writing. It is essential to switch ZIP compression off before export, otherwise the browser will not be able to find the source images later on. Once you have done this, only the *Flat* projection option is not grayed out. There are details on how to create other projection types using this option below.

If you select the *Automatic* option, the browser automatically detects whether it is better to use the *HD View* plug-in or the less powerful *Silverlight* viewer. The files the program generates are compatible with both. Here too, ZIP compression should be switched off.

If you want your results to work on the widest possible range of platforms, you should choose either the *HD View SL* or *Automatic* option, although the former produces the most consistent results on a range of browsers. The *HD View* plug-in flashes a very obvious logo before displaying an image, which makes it slightly irritating to work with.

You can work aorund the *HD View* plug-in's inherent inability to display cylindrical or other 'endless' formats by making a small adjustment to the HTML code it generates.

Rather than altering the projection type that is written in plain text in the HTML file, you need to do the following:

Select the *Automatic* Viewer option and the *Cylindrical (Horizontal)* Projection option and then click OK. Open the HTML file that the process creates in your target folder and look for the line of code that reads <args='FileName=#hdvxmlembed&BackgroundColor=0&Viewer=2'> (which will probably be line 37). The final '2' stands for the selected viewer option – in this case, *Automatic*. Simply change the '2' to a '1' (i.e., *HD View SL*) and save the file. 360-degree panoramas will now be displayed as such. With a bit of basic HTML know-how you can also hide some of the information in the task bar and customize the layout of the viewer window on your website.

Zoomify

Adobe's *Zoomify* Flash Player plug-in has virtually no compatibility issues and as a result is much more widely used than *Silverlight*. The Flash export option has been built into *Photoshop* since the CS3 release and can be reached by way of the File > Export > Zoomify command. In addition to a Flash file (with its .swf extension), the tool also creates an appropriate tileset and Web code. Overall, *Zoomify* has fairly limited functionality. The maximum window size is just 1,000 pixels and the projection type is always 'flat'. You can add a navigator window at the top left corner of the frame, but crops and zooms are generally not very smooth and bear no comparison with Microsoft's superior Deep Zoom technology.

We couldn't find a *Zoomify* plug-in for *Photoshop Elements*, although the standalone *Zoomify Express* (available free for Mac or Windows at www.zoomify.com) can create tilesets from JPG, TIF and PSD files. The program doesn't support PSB images and maximum image length is limited to 65,535 pixels. It also lacks a dedicated Web embedding functionality, so you have to deal with that aspect yourself. On the plus side, a template and the required ZoomifyViewer.swf Flash application are included. The commercial *Design* and *Flash*

The *Photoshop Zoomify* dialog and the browser window it creates. The navigation bar is always located at the bottom of the frame.

Dragging an image file to a *krpano* 'droplet' in the Explorer window automatically creates a gigapixel panorama (above)

The MULTIRES droplet can be used to create 360-degree spherical panoramas with variable projection types that can be selected using the context menu (on the right)
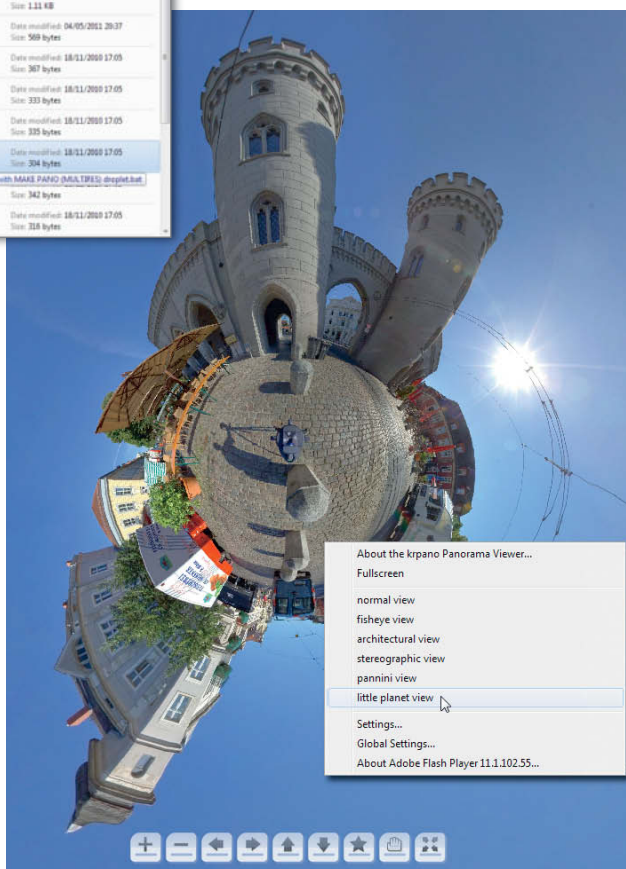

versions of the software (US$29 and US$69) offer more flexibility, although neither supports PSB, which means that they are not really gigapixel-compatible.

krpano

Our favorite Flash Viewer application is one you are sure to have come across at some point. The program with the unpronounceable name was written by an Austrian, Klaus Reinfeld, and provides the background technology for many of today's best-known gigapixel panoramas, including the famous 111-gigapixel panorama of the city of Seville. *krpano* is actually a whole set of programs, tools and templates. Once you have downloaded the complete package to your hard disk, you can start work without performing any additional installation. The software doesn't use conventional program windows or file dialogs, but instead requires the user to drag the selected image to one of a number of 'droplets', which then automatically runs a batch file that performs the desired conversion routine. The program includes a blue progress window that is strongly reminiscent of DOS programs, and which displays each step as it takes place.

The only way to adjust what each tool does is to manually manipulate the appropriate
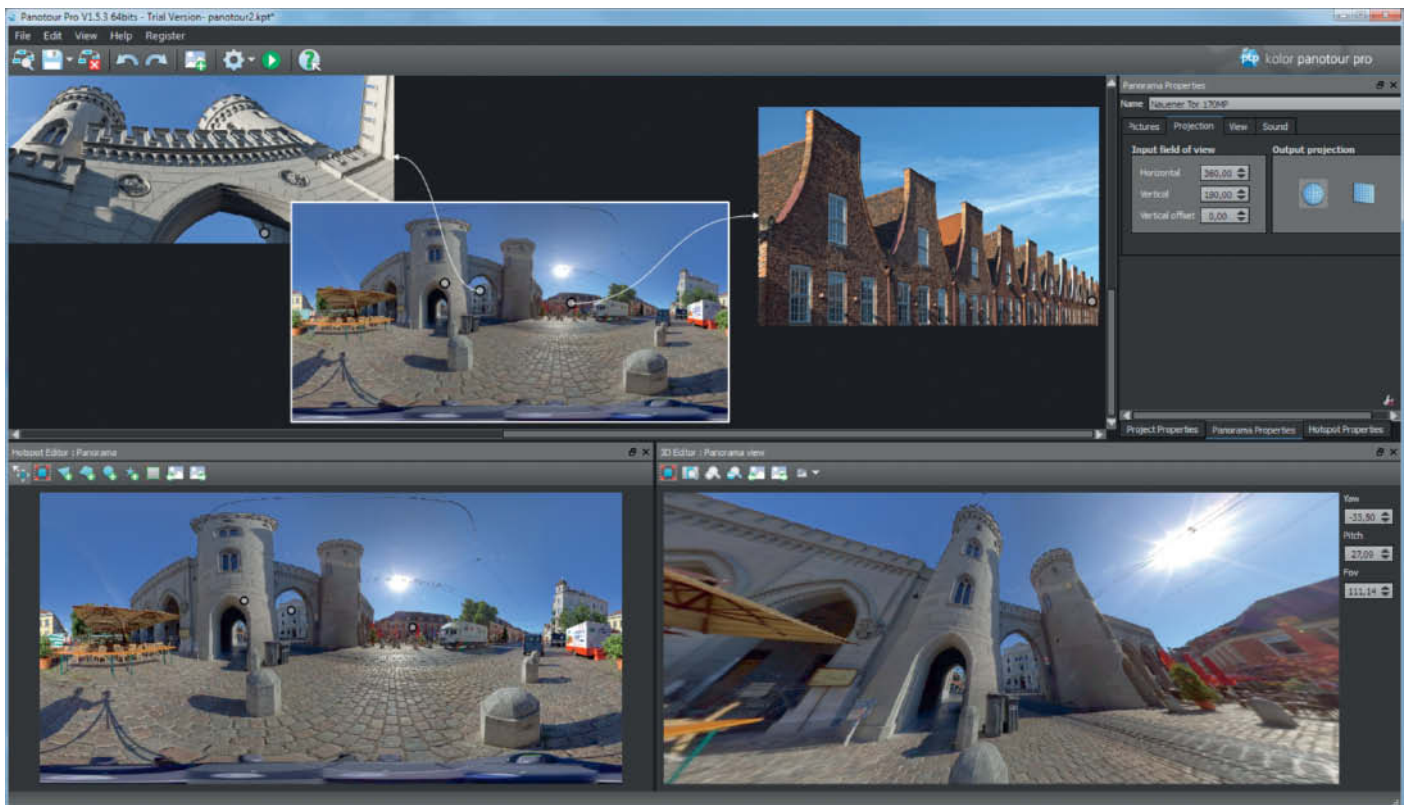
configuration file. However, this is not generally necessary, as the default settings are designed for use in real-world situations and each droplet is fine-tuned to cover various standard situations. The NORMAL droplet produces an interactive panorama without the use of a tileset, and is thus suitable for use with conventionally sized images. The FLAT and MULTIRES droplets can handle images of any size (including PSB files) and split these into tilesets. FLAT is, obviously, for creating flat, perspectival panoramas, while MULTIRES is for creating cylindrical and spherical panoramas. If the input field of view and the output projection type are not evident from the image dimensions or the embedded metadata, the program requires you to enter them manually.

The conversion process creates a new folder in the source image folder that contains the new tileset, a 'skin' folder with the navigation icons, the Flash viewer, an XML settings and links file, a JavaScript file that controls (amongst other things) navigation and a small HTML file for displaying the new image on the Web. All files are named after the original image and a double click on the HTML file opens the image in a browser window. You can then fine-tune this file or simply copy its contents to an existing Web page. If you want to embed you files in a different website, make sure that the relative

paths for all files and folders remain consistent and intact within the new site structure.

The Web pages that *krpano* produces look better than anything that Microsoft or *Zoomify* are capable of. Navigation is smooth, full frame is the default view and there are no apparently random limitations to functionality. The only real reason to think twice about using *krpano* is the €107 price tag for a license for the viewer and the full toolset. The iPad/iPhone viewer – which can only display spherical panoramas with a maximum size of five megapixels – costs an additional €47! A plug-in for embedding Google Maps in the resulting Web page also costs €23. If you don't purchase a license, the images you produce contain a watermark and can only be viewed offline. *krpano* is available in 32-bit and 64-bit versions for Windows, Mac and Linux.

Getting to know *krpano* in depth requires quite a lot of time and some programming know-how, but your efforts will be rewarded with unusual custom image presentations. Some of the Web pages included in the templates folder are top-notch and, once you have familiarized yourself with the way the software works, you can copy the code and adapt it to your own requirements.

The *krpano* toolset includes droplets for creating virtual tours that include hotspots for linking sequences of images with simple

Kolor's *Panotour* makes it quick and easy to create entire virtual tours, and even supports gigapixel images in the process

mouse clicks. The same principle can be used to create a tour of interesting details within a single gigapixel image, and the hotspots reside as thumbnails at the edge of the image frame. gigapan.org uses this technique and calls the resulting thumbnails 'snapshots'. Creating snapshot thumbnails using *krpano* isslightly more complex and requires a fair amount of manual programming. There is, however, a program available called *Panotour*, which has a graphical interface and is designed specifically for producing multi-image virtual tours. *Panotour* is based on the *krpano* back end, but is not as good for creating tours through single gigapixel images as it is for linking multiple images. Not only that, but the gigapixel-compatible Pro version costs €357.   (anm) **c't**

Petra Vogt

Your iPad Assistant
on location or in the studio

A conventional notebook computer is still the tool of choice for many photographers when it comes to viewing, rating and keywording images during a shoot. The iPad, with its low weight and simple handling, is a real alternative, but requires a little tweaking and network setup before you can get to work. Once you have got things up and running, you will be the proud owner of a complete iPad photo workflow that assists you with all aspects of your shoot, from image capture to data download to your home or studio computer.

Wired Shooting Support

Apple's iPad Camera Connection Kit costs US$29 and comprises an SD card reader with a dock plug and a USB adapter for connecting your camera. Photos have to be imported before they can be viewed at full size, which takes time, so it is usually better to wait until you have finished a shoot before you transfer your image files.

Genuine tethered shooting – i.e., controlling the camera remotely via live view on the iPad screen – is not possible using the connection kit because there is currently no app available to join the various hardware components. At the time of writing, neither Canon nor Nikon were willing to say whether or when such an app might be released.

Tethered shooting using a notebook or desktop computer is relatively simple with the help of a workflow program such as *Lightroom* or, in the case of Canon, the proprietary *EOS Utility* provided free with Canon DSLRs. For more information on remote triggers for DSLRs, see our article in Issue 2 of *c't Digital Photography*.

This means at the moment that the only way to perform tethered shooting with an iPad is to use a notebook as an additional link in the chain and to transfer the screen content wirelessly to your iPad, which then functions as a kind of remote monitor. This kind of setup works well on a PC with *MaxiVista* (US$9.99)

or on a Mac using *Air Display* (US$9.99). The major drawback with the PC solution is that you control what happens on the iPad screen using the computer's input device rather than the iPad's own touch screen interface, which takes some getting used to and is not particularly user-friendly.

DSLR Camera Remote from onOne Software is a more advanced, iPad-friendly solution that allows you to control your camera directly via the iPad interface, although you still require a notebook to complete the setup. The basic software is free, but the app costs US$49.99 and only supports Nikon and Canon cameras. In additional to the basic shooting parameters, the app also supports interval shooting.

The *Capture One* RAW converter and the *Capture Pilot* app manufactured by Phase One provide a different approach to wired iPad shooting. The app is free but the Pro version of the RAW processing package costs around US$400, making it an unlikely choice for pure tethered shooting purposes. However, if you already own *Capture One*, the app is a useful bonus.

All in all, the current crop of wired iPad camera control solutions is easy to install but still fairly clunky in use. The alternative, which offers the photographer much more freedom, is to use a wireless connection.
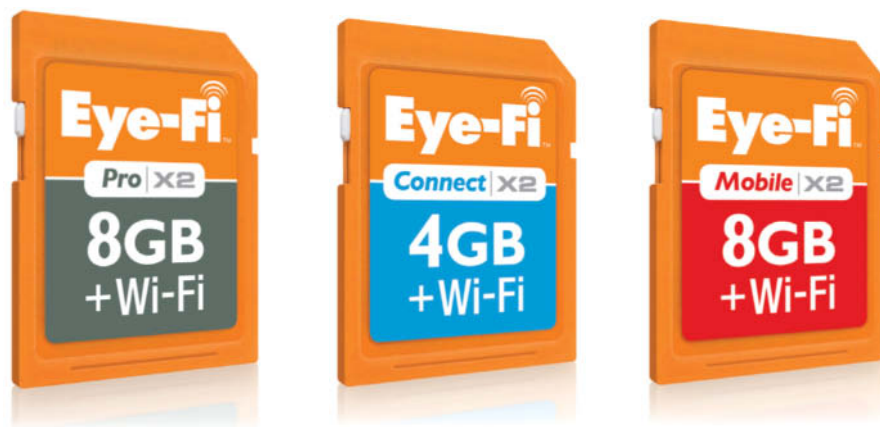

At US$49.99, onOne's *CameraRemote* app is a fairly costly way to control your camera via your iPad. The app can display live view video in real time, but only works with Canon and Nikon cameras, and you will need an additional notebook computer.

In this article

Wireless Image Transfer

A wireless connection between your camera and your computer is the obvious choice if you are out and about, but be warned – apart from one rather expensive Canon solution (which we will discuss later), it is still not possible to project a live view monitor image onto your iPad, so the main function of the iPad is still viewing images once they have been captured. The first step in getting your camera to perform this way is to give it wireless support, and the cheapest way to do that is using a memory card with built-in wireless functionality. These are currently only available from Eye-Fi or its co-brand, SanDisk. Eye-Fi memory cards are priced at US$50 and upward and are capable not only of saving images files but also of transferring them wirelessly to various memory media.

Toshiba's FlashAir wirelessSD cards, announced in September 2011, are due for release in early 2012 at as yet unknown prices. Canon and Nikon offer their own wireless solutions, but these start at around US$500, which is why we focused on the Eye-Fi solution for this article.

The Eye-Fi Wi-Fi module supports the 802.11 b, g and n standards, but only the X2 model is capable of transferring RAW image files in addition to JPEGs and videos. The X2 version is not officially available in Europe, but ordering from amazon.com or other international suppliers is quite straightforward.

Eye-Fi doesn't offer Wi-fi-capable CompactFlash cards and explicitly advises against using its SD products with CF adapters. Other sources have reported

Eye-Fi SD cards are the cheapest way to connect an iPad to your camera wirelessly, although they can be quite tricky to set up. Identical cards have been available in Europe under the SanDisk co-brand since late 2011.

success using this method, but it is up to you to decide whether you want to try it. The most reliable cards for adapter-based use are the latest X2 models, as earlier models sometimes don't write all the image data to the card's memory. There are various reports floating around of certain cameras that are less cooperative with Eye-Fi cards, although regular firmware updates seem to help in a lot of situations. Eye-Fi itself explicitily warn against using its products with the Leica M9, as this can cause physical damage to the camera's card slot.

Eye-Fi cards are installed using a computer-based wizard rather than on the iPad or in-camera, and are set up by default to communicate with the Internet rather than with separate devices. To configure the card for use with an iPad, you have to switch to Direct Mode in the card's Network settings, which enables direct networking without the use of a router. Eye-Fi support recommends using either the *4 minutes* or the *Forever* Wait after Transfer option, and these have proved useful in practice. The illustration opposite shows exactly which of the card's network settings have to be entered in the iPad's Wi-Fi settings dialog.

Problems can occur if the Eye-Fi card or the iPad automatically connects with a

Wi-Fi and iPad Camera Adapters

Product	iPad Camera Connection Kit	Eye-Fi Connect X2	Eye-Fi Mobile X2	Eye-Fi Pro X2	SanDisk Eye-Fi 4GB	SanDisk Eye-Fi 8GB	WFT-E4 II A	WT-4a
Manufacturer/Reseller	Apple	Eye-Fi	Eye-Fi	Eye-Fi	SanDisk	SanDisk	Canon	Nikon
URL	www.apple.com/ipad/accessories/	www.eye.fi/products/connectx2	www.eye.fi/products/mobilex2	www.eye.fi/products/prox2	sandisk.co.uk/products/wireless-memory-cards/sandisk-eye-fi-wireless-memory-card	sandisk.co.uk/products/wireless-memory-cards/sandisk-eye-fi-wireless-memory-card	www.usa.canon.com/cusa/consumer/products/cameras/consumer_cameras_wft/wireless_file_transmitter_wft_e4_ii_a	imaging.nikon.com/lineup/microsite/d300s/en/accessories/
Details	Kit includes SD card reader and USB camera connector, both with iPad Dock connectors	SD memory card with built-in Wi-Fi capability (802.11b/g/n), 4 GB memory, doesn't support RAW transfer, Class 6	SD memory card with built-in Wi-Fi capability (802.11b/g/n), 8 GB memory, doesn't support RAW transfer, Class 6	SD memory card with built-in Wi-Fi capability (802.11b/g/n), 8 GB memory, with RAW transfer support, Class 6	SD memory card with built-in Wi-Fi capability (802.11b/g/n), 4 GB memory, doesn't support RAW transfer, Class 4	SD memory card with built-in Wi-Fi capability (802.11b/g/n), 8 GB memory, doesn't support RAW transfer, Class 4	Wi-Fi Adapter with 802.11 a/b/g support. Dedicated to EOS Canon 5D Mark II. Other models avaiable (WFT-E1/E1A, WFT-E2/E2A, WFT-E3/E3A etc.) for other cameras.	Wi-Fi Adapter with 802.11 a/b/g support. Compatible with D3X, D300, D3, D700, D300S.
Street Price	US$29	US$50	US$80	US$100	45 €	65 €	US$690	US$700

known WLAN, and direct communication between the card and the separate Eye-Fi app only works via a direct connection. If you are having problems, check that your iPad's Wi-Fi settings display a connection to the Eye-Fi Card (see also our Help box on page 56). Some cameras, such as the Canon EOS 550D (Rebel T2i) and the Nikon D300, allow you to view and troubleshoot Eye-Fi network settings via the camera's menus when the card is inserted. Care is required when using this type of connection, as you can accidentally deactivate the connection in the camera. Don't use the Endless Memory setting, as this automatically deletes image files from the card once they have been transferred to your computer. Once you have set up your connection, you will need an app to receive and display the images you capture. Eye-Fi provides its own free app for the latest X2 generation cards. For the app to work with RAW image files as well as JPEGs, the *Receive Media* option in the iPad's card settings has to be switched on.

For US$15.99, the **Shuttersnitch** app offers more comprehensive functionality than the free Eye-Fi alternative. It works with earlier generation Eye-Fi cards and lets you transfer images either directly between devices or via a router. The app also has a number of really useful tools, including automated keywording after image capture and a slide show with zoom effects and music from your iTunes collection that you can control directly from
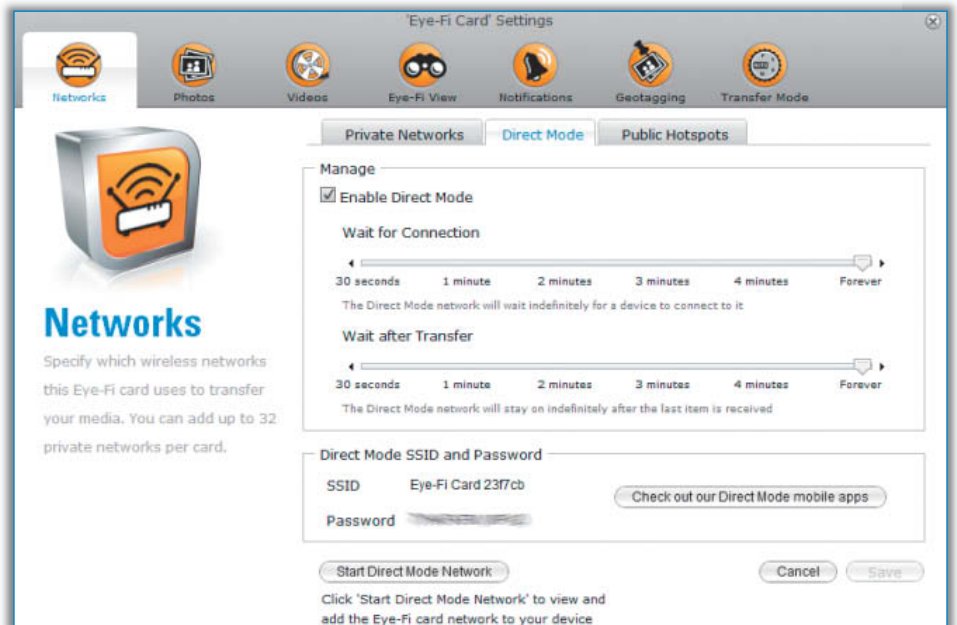
Eye-Fi cards have to be switched to Direct Mode in order to connect the camera directly to your iPad. This dialog also displays the SSID and the password of the device you are connecting to.

the app interface. It also displays the current connection status and IP address, which makes troubleshooting a lot easier. The only downside in comparison with the Eye-Fi app is that, even though it can transfer them, *Shuttersnitch* cannot display RAW images. If

you have both apps installed on your iPad, you have to switch Eye-Fi off before *Shuttersnitch* will work.

Once you have setup your card and your app, images you capture are saved on the card before being transferred to your iPad.

Shuttersnitch **can perform automatic actions for captured images, including adding keywords to image metadata**

The *Receive Media* option has to be activated in the iPad's Eye-Fi card settings in order to display images captured on the card. Confusingly, the switch is only available if you have an active Internet connection – the menu doesn't appear if you are working in Direct Mode.

Transfer for the first JPEG in a series takes between five and 10 seconds, but subsequent files are transferred much faster. RAW files from a 16-megapixel camera such as the Nikon D7000 take between 10 and 30 seconds per image, which is not particularly useful during a portrait shoot. A practical solution here is to shoot in RAW and JPEG formats and to transfer just the JPEGs to your iPad. JPEGs are usually of sufficient quality for rating and keywording purposes and are much quicker to process. You can then transfer your RAW files to your home computer in your own time.

The Eye-Fi app and *Shuttersnitch* both support separate RAW and JPEG transfer and both require RAW transfer to be explicitly activated. If your camera has two card slots, you can have it record the JPEG version of your photos to the Eye-Fi card and the RAW files to the other. This approach also means that you don't have to separate the two batches of shots later when you transfer your work to your main computer.

If your camera isn't SD-compatible, or if you prefer to use proprietary technology, you can always use a camera manufacturer's own wireless solution, such as the Canon WFT-E4IIA (starting around US$600) or Nikon's WT-4a (from US$700). Their price and exclusively high-end compatibility indicate that these models are aimed at professional press and studio photographers rather than at the hobby end of the market. They are also quite tricky to set up but, in addition to the thick manuals supplied, there are a number of YouTube videos that explain how to use them with an iPad. One of the major advantages of high-end adapters is that they can log in to local Wi-Fi networks as well as work via direct connections to an iPad. They also have much greater range but are correspondingly bulky as a result.

Nikon's own wireless transfer solution is much more expensive than Eye-Fi and is built into an external transmitter that is attached to the camera via USB. Prices start at around US$700.

Tethered Shooting
Using the Canon Adapter

Canon's wireless adapter supports genuine wireless tethered shooting without the use of an additional computer, and includes live view pre-release composition and remote shutter release via the iPad interface. Instead of using a native app, Canon transfers the camera controls and monitor image to a dedicated website that is then accessed by the iPad's browser. The consequence of this roundabout system is that the live view image suffers from visible lag that is just about tolerable for non-moving subjects, but is no use at all for shooting sports.
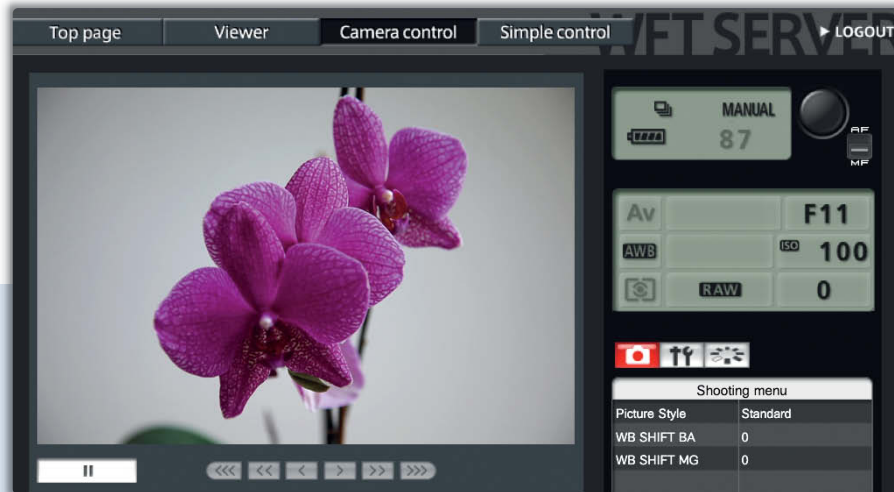
The Canon WFT 4IIA wireless adapter costs around US$650 and attaches directly to the camera's baseplate. The unit supports genuine tethered shooting, but suffers from distinct monitor image lag.

Rating and Keywording Your Images

It usually saves time and effort to rate and keyword your images immediately after you have transferred them to your iPad. Many digital photographers like to use asset management software such as *Lightroom*, *Aperture*, *Adobe Bridge* or *Picasa*, but as yet, none of these has its own iPad app to go with the main software package.

However, there are dedicated third-party apps available for use with *Lightroom* and *Aperture* – but more on those later. As an alternative, there are also apps available that write standardized IPTC or XMP metadata to your images from a variety of source programs. One of these is *Shuttersnitch*, which we introduced earlier and which can automatically write preset metadata to all captured images before you begin to add individual keywords and ratings. *Shuttersnitch* also retains the original filenames (which is not always the case with other apps), includes visual under- and overexposure warnings and supports automated upload to your e-mail program, FTP servers, Dropbox, Flickr, Facebook, Smugmug, Zenfolio and others. Its only real drawbacks are its inability to display RAW images (should you really want to) and its rather limiting single metadata field.

The automated actions on offer include writing the photographer's name, copyright info, photo description, source information and geodata to image files. Geodata is taken from the iPad's last recorded coordinates, so is of no use if you do not keyword your holiday snaps until you get home. *Lightroom* has no problems displaying metadata that you enter using *Shuttersnitch*. However, care is required when using the Source data field, as *Lightroom* displays its contents in both the Creator field of a file's contact data and as the author of the description listed in the IPTC Content section.

Shuttersnitch doesn't allow you to write more than one description as metadata and has problems handling RAW files. *PhotosInfo Pro* and *Filterstorm Pro* are both more flexible in these respects.

Filterstorm Pro (US$14.99) supports writing metadata to multiple images and allows you to save custom sets of IPTC data fields as presets. *Lightroom* has no problems displaying metadata entered using the app, although there are some discrepancies between the names of corresponding data fields. For example, the *Lightroom* IPTC Subject Code field is called Subject in *Filterstorm Pro*. If you are in any doubt, it is always better to check that both sets of data fields precisely fulfill your particular needs.

Filterstorm Pro processes captured images before exporting them and is therefore slower than *Shuttersnitch*. It also supports RAW image files, although the 1.4 version we tested was only capable of exporting image files with metadata as JPEGs and crashed quite often in the process. Here too, it is better to work with just JPEGs on your iPad and to synchronize metadata with your RAW files later on your home computer.

PhotosInfo Pro (US$9.99), by Dmitri Toropov, offers a smarter solution. If you shoot simultaneously in JPEG and RAW, the app uses just the JPEG files for its internal processing and produces a speedy monitor image as a result. You can then choose whether to export just your RAW files, or even just your XMP metadata. The program's main drawback is that it only supports data transfer via e-mail or iTunes (i.e., Dropbox, iCloud and FTP aren't part of the package). It also supports fewer IPTC fields and cannot save IPTC sets the way *Filterstorm Pro* can. The feature we missed most is a 1:1 preview, although this should be included in the latest version by the time you read this.

Sort Shots and **MetaEditor** are two further rating and keywording apps. *Sort Shots* is limited to JPEG handling and neither app is capable of saving IPTC data field sets. *Sort Shots* does, however, include a range of other features, including advanced sorting and slide show presentation and proved to be more stable than *Filterstorm Pro* during our tests.

Camera-to-iPad Connection Help for Eye-Fi SD Cards

Getting Eye-Fi cards to communicate with your iPad isn't always easy. Here are a few of the common pitfalls involved and some tips on how to avoid them:

The card is logged into a different Wi-Fi network instead of communicating directly with your iPad.

This happens as soon as the card is within receiving range of a known network. Because the card has no user interface of its own, this is impossible to check in real time. The safest way to avoid this type of conflict is to delete all other networks using your computer's control panel/system preferences. As an alternative, you can also use the *Shuttersnitch* app, which supports data transfer via a router.

Your iPad connects to a different Wi-Fi network instead of to the Eye-Fi card.

The card and the iPad have to be part of the same network – i.e., the card's network in Direct Mode or the router's network. The Wi-Fi section of your iPad's Settings tells you which network it is currently logged in to.

The Eye-Fi app is not set to Receive Media.

You have to make this setting manually in the app's settings. The setting is only available if you are connected to the Internet, so you have to make it before you switch to a direct connection between the camera and the card. If you are using *Shuttersnitch*, you have to activate Eye-Fi card usage using the *Set up Eye-Fi access* option in the app's Options dialog.

You have captured RAW images and want to transfer them to your iPad.

You have to activate RAW transfer separately using the *Receive Media* option. This is not immediately obvious, and the additional options are only visible if you have just switched the option from 'Off' to 'On'. You can then choose which types of media transfer you want to activate.

In *Shuttersnitch*, the RAW options are part of the Shuttersnitch section of the iPad's Apps Settings. There, you have to navigate to the *Eye-Fi Transfers > Accept JPEGs Only* option.
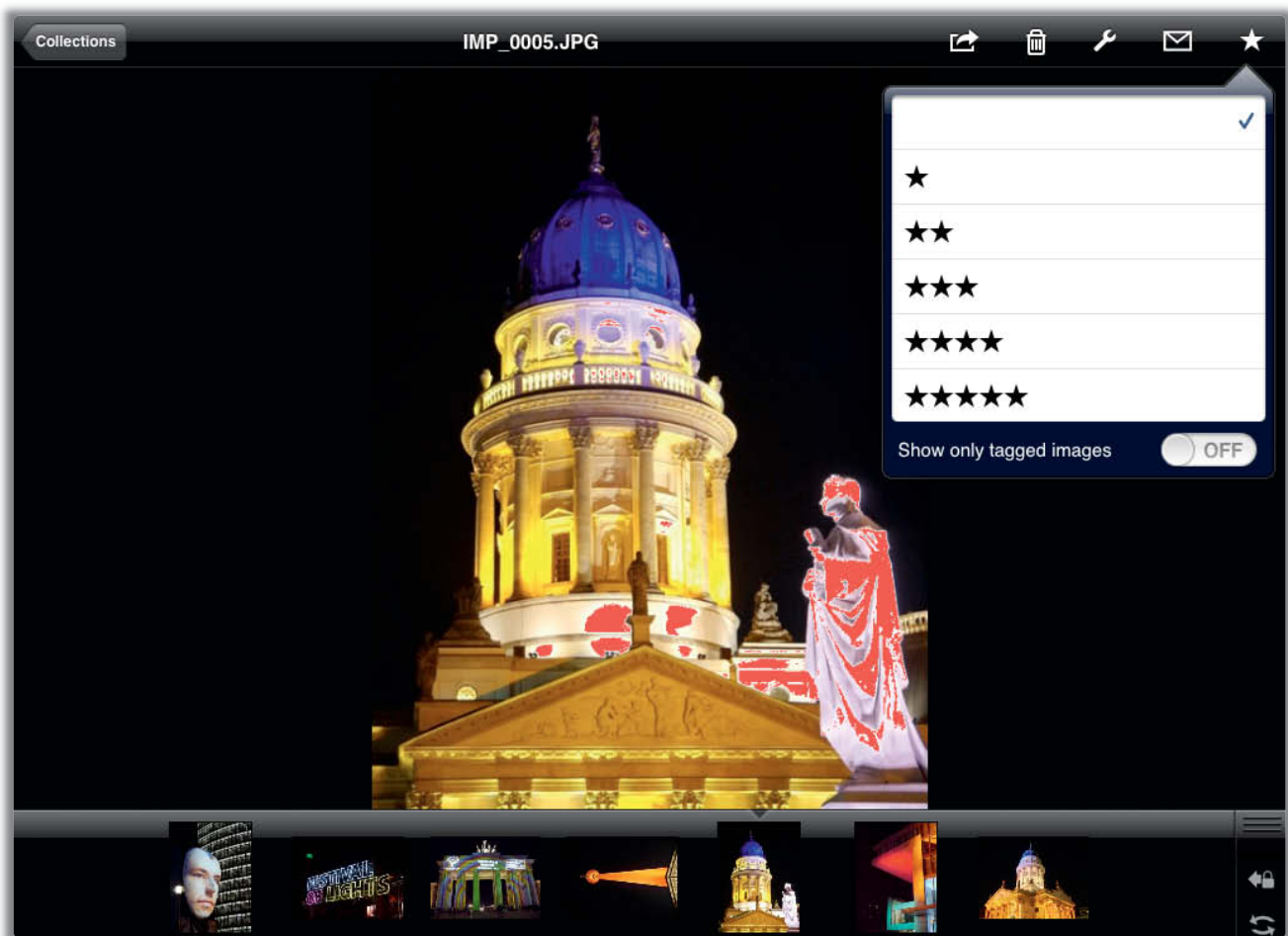
Shuttersnitch can not only import images from your camera, but can also be used to rate them and warn you of under- or overexposure (indicated by the red-filled areas in the illustration)

Once you have rated and keyworded your images, you will need to export them to your home computer for long-term archiving. None of the apps we have introduced offers direct replication with asset management programs like *Lightroom*, and they all use e-mail, Dropbox, Flickr or FTP to transfer image data to the cloud or via wired sync to iTunes.

Importing Images to Your Asset Management Database

We have used *Lightroom* to describe the steps involved in image data transfer, although the same principles apply to most similar programs. You can make the process much more efficient if you use the Auto Import command in the File menu to create a folder that the program continually monitors for new images. These are then automatically imported into the Lightroom database. You can, for example, set up an Auto Import folder inside the Dropbox folder used by *Shuttersnitch* to save JPEGs or *PhotosInfo Pro*

to save RAW files. You can then continue to work in the normal way within the *Lightroom* interface.

If, as suggested, you are working with JPEGs on your iPad and RAW files on your home computer, you will still have to import the RAW files from your camera and synchronize them with the metadata included in your keyworded and rated JPEGs. To help you achieve this, activate the *Treat JPEG files next to RAW files as separate photos* option in the *Lightroom* Preferences dialog and check that your RAW and JPEG files have the same basic filenames. Images transferred wirelessly using *Shuttersnitch* automatically have the same filenames, whereas all the other apps listed give files new, proprietary names. If this is the case, you will need to batch rename your files so that each JPEG/RAW file pair differs only in its extension. The Lightroom batch rename function can be started by pressing the F2 key, but other free programs, such as *XnView* or the *FastStone* viewer, have great batch rename functionality too. Make sure that you have the same number of RAW
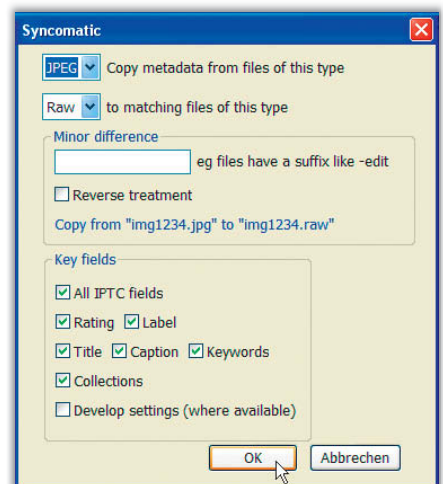
The *Syncomatic* plug-in for *Lightroom* automates metadata synchronization between files with identical names but different extensions. *Syncomatic* also helps you to sync stacks of files that have been imported from different sources – for example, JPEGs from your iPad and RAWs from your camera.
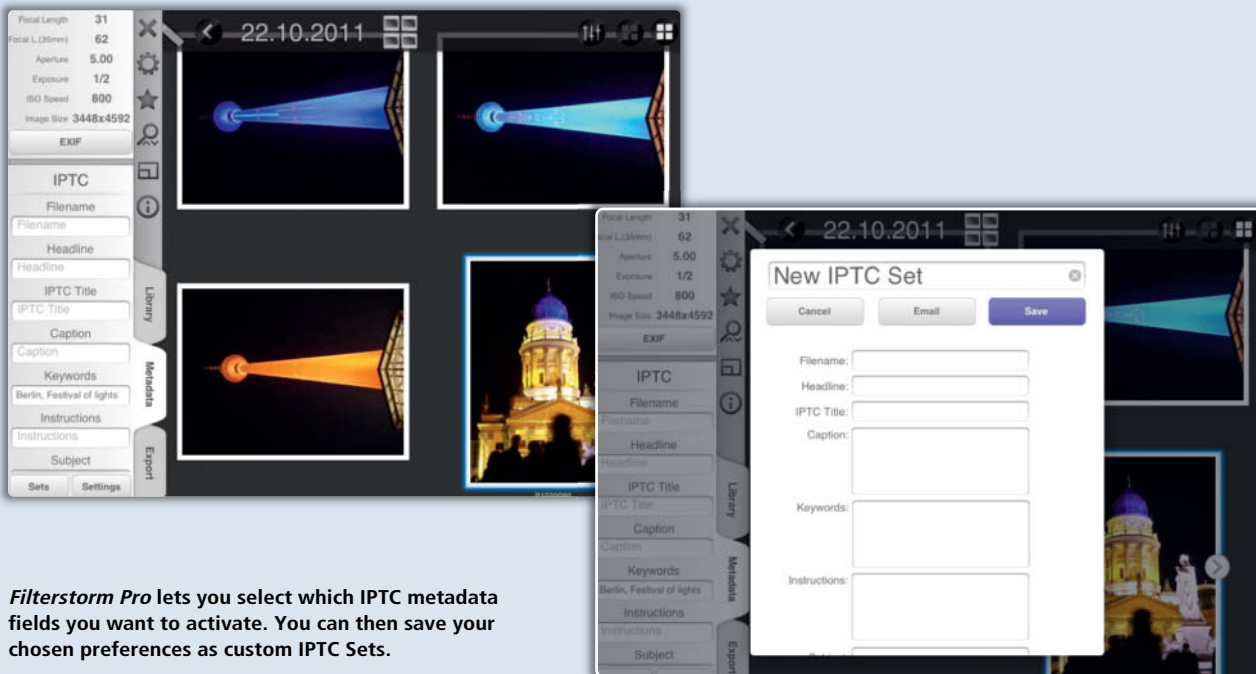
Filterstorm Pro lets you select which IPTC metadata fields you want to activate. You can then save your chosen preferences as custom IPTC Sets.

and JPEG files in the source folder before you start, otherwise the file order will get messed up during the process.

The *Syncomatic* plug-in for *Lightroom* (£8.00, approx. US$12.50) is a great tool for synchronizing image metadata automatically, and saves a great deal of time and effort.

By now, you are probably thinking that this all sounds like a lot of hard work, but remember that once you have made the effort to set up and automate your workflow for the first time, your photographic life with your iPad will become a lot easier on every subsequent shoot.

Using Photosmith with Lightroom

The workflow described above is not particularly elegant to set up, but works with a number of different asset management programs, including *Aperture*, *Bibble* and *Bridge*. If, however, you are looking for a purely *Lightroom*-based solution, *Photosmith* (US$17.99) is a relatively simple answer. The app supports rating and keywording and transfers your files directly to *Lightroom*. Once you have installed the app, the first step is to set up automatic image import from your iPad's photo folder. The *Photosmith* rating and keywording tools use the same star, flag and color code tools as *Lightrooom*, but please note that if you give an image a black 'reject' flag, it won't be exported at all.

Photosmith doesn't support advanced Adobe keywording features such as the use of synonyms, and instead requires you to either select each keyword manually from a list or enter a new one for each image. This makes comprehensive keywording quite time-consuming but, according to the developer, batch keywording is slated for inclusion in future versions. However, if you already own *Shuttersnitch*, you can use it to batch keyword your images (see page 56) before exporting them to your iPad's photo album and using *Photosmith* to complete your metadata entries. You can, of course, use *Lightroom* itself to add metadata, but only if you happen to have your notebook or other full-featured computer with you.

Sample iPad Photo Workflow

Of the many approaches we have discussed, our tests have shown that the following is the most reliable way to construct a wireless iPad-assisted photo workflow:

In Your Camera:
- Use Eye-Fi card or other wireless adapter
- Shoot in RAW + JPEG format
- Transmit JPEG files wirelessly to iPad

On Your iPad:
- View, rate and keyword using apps like *Shuttersnitch*, *Filterstorm Pro*, *PhotosInfo Pro* or *Photosmith*
- JPEG transfer from iPad to home computer either via cable, FTP, Dropbox, iTunes or from within the *Lightroom* interface using *Photosmith*.

On Your Desktop/Notebook:
- If your app automatically alters filenames, batch rename your JPEGS and RAWs so that they have the same basic filename
- Import your RAW files from your memory card (Eye-Fi cards have either 4 or 8 GB of built-in memory) and your JPEGs to your asset management program (using an Auto Import folder if required)
- Synchronize your RAW and JPEG metadata (in *Lightroom* using the *Syncomatic* plug-in)

Photosmith and *PhotosInfo Pro* support RAW-only shooting, which has the disadvantage of large file sizes throughout the workflow, but the advantage of no longer having to rename files and synchronize metadata between different file types.

The free **Photosmith Plug-in** forms the bridge between *Photosmith* and *Lightroom*. Simply set the app to 'Sync with Lightroom' and import your images using the Plug-in Extras > iPad to Lightroom Sync command in the *Lightroom* interface. *Photosmith* also recommends importing your images via iTunes and synchronizing your metadata later using iPad to Lightroom Sync. We tested the software with various computers, but neither method was really stable – sometimes, some of the images in a collection were not transferred, and RAW transfer was slow or froze completely.

Aperture and iPhoto

For completeness' sake, we would like to mention the **Pixelsync** app (US$7.99), which is designed to bring Aperture and iPhoto to your iPad. The app is, however, only capable of importing images from a 'full' computer to an iPad, making it less practical for use on the road.

Conclusions

The benefits of using an iPad with your digital camera are obvious: it is much easier to check image quality on the large screen and immediate, semi-automatic rating and keywording is much quicker than it is if you wait until you get home. However, genuine tethered shooting with full, real-time camera control is only possible in conjunction with costly additional hardware and setting the system up takes time and a fair amount of know-how.

The cheapest but bulkiest way to use your iPad as your location assistant is to take your notebook along with you. You then only require the Apple Camera connection Kit (for US$29) and either the *MaxiVista* (US$9.99) or *Air Display* (US$19.99) app. You will also need to install *Lightroom* or Canon's free *EOS Utility* on your notebook. In this case, your iPad simply acts as an extended, wireless monitor that uses touch gestures for viewing your captured images.

Wireless viewing without using a notebook is more expensive and more complex to set up and the only true tethered shooting solution uses the very expensive Canon WFT wireless transmitter. The cheapest wireless option is an Eye-Fi card (from US$50), although setup is not trivial and requires a fair amount of patience (see also the Help box on page 56).

Keywording on location using an iPad would be a fantastic option if only there was a fast, stable app available that supports comprehensive metadata fields, full import into asset management software and multi-file RAW handling. While we wait for someone to come up with our dream app, we

Photosmith uses the familiar **Lightroom** stars, flags and color code rating systems. If you rate a photo with a black 'reject' flag, the program won't transfer it from your iPad to *Lightroom*.

Android Alternatives

There are not nearly as many photo apps available for Android as there are for the iPad. The Eye-Fi Android app is the only currently available solution for performing data transfer the way we have described.

If you already use a Canon adapter, the fact that the interface runs via an Internet browser means that you can use it with any Android tablet. *Sort Shots* is the only one of the metadata processing apps described that is currently available for Android.

Canon cameras support wired tethered shooting via USB with Android 3.0 and higher. DSLR Controller (US$8.50) gives you tablet access to exposure time, aperture, ISO, white balance and even focus settings. We would love to see this app ported for iOS!

There are, as yet, not many photo apps available for Android-based tablets. *DSLR Controller* is one of the few currently available solutions, and gives you full wired control of all the camera's most important settings.

Photo: Chainfire

can thoroughly recommend shooting in RAW+JPEG mode and working with just the JPEG files on your iPad. This approach takes more effort, but is faster and more stable than some of the others on offer. There are also more apps available for managing and processing JPEG image files. Our favorite app is *Shuttersnitch*, closely followed by *Filterstorm Pro* with its limited but nevertheless useful RAW handling and wide-ranging IPTC metadata functionality.

PhotosInfo Pro is the best choice if you really need to work with a large number of RAW files or you want to export XMP metadata separately from your image files. Otherwise, it is not as fully featured as the competition and doesn't offer a 100% preview.

Attention all photo app developers out there! Please make us an app with the speed and user-friendliness of *Shuttersnitch*, the IPTC functionality of *Filterstorm* and RAW handling that compares with that built into *PhotosInfo Pro*. Thank you!

Until then, we will continue to manually meld our iPad JPEGs with our camera-based RAW files as described above.

We can also hardly wait for the day when camera and software manufacturers begin to create apps that use the iPad as a full-blooded viewing, rating and image transfer tool.

Windows tablets are capable of running many applications that you can normally only use on a 'full' computer, making them a real alternative to the iPad, and Eye-Fi installation is also a snap in the Windows environment. Currently, there are simply not enough Android photo apps out there to make Android-based tablets a viable alternative.   (jr)

iPad Photo Apps

App	URL	Price	Comments
Air Display	www.avatron.com/apps/air-display	US$9.99	iPad as extended monitor
Capture Pilot	www.phaseone.com/en/Software/Capture-Pilot/Overview.aspx	Free	RAW converter for wired iPad use. Required Mac/Win software costs about US$400 extra.
DSLR Camera Remote	www.ononesoftware.com/products/dslr-camera-remote	US$49.99	App supports direct camera contorol via the iPad interface. Required desktop software is free.
Eye-Fi App	www.eye.fi/products/iphone	Free	Free app for wireless connection between camera and iPad
Filterstorm Pro	http://filterstorm.com/pro/	US$14.99	Great for adding metadata. Saves custom sets of IPTC data fields. Good Lightroom interoperability.
MaxiVista	www.maxivista.com/de/ipad_monitor.htm	US$9.99	App for using your iPad as an extended monitor
MetaEditor	http://cyrilgodefroy.com/metaeditor.html/	US$4.99	App for keywording and rating photos.Doesn't support IPTC data field sets.
PhotosInfo Pro	http://photosinfoapp.blogspot.com/2011/06/why-photosinfopro.html	US$9.99	Smart RAW and JPEG metadata processing app
Photosmith	www.photosmithapp.com	US$17.99	Great Lightroom integration. Especially good for rating and file transfer.
Shuttersnitch	www.shuttersnitch.com	US$15.99	Works well with Eye-Fi cards duringdata transfer. Includes some automated metadata functionality.
Sort Shots	www.sortshots.com	US$5.99	Metadata editor that only works with JPEGs. Doesn't support data field sets.

c't

Tilo Gockel

Pseudo DRI

Only the Best Will Do ...

The idea of using only the very best pixels from a bracketing sequence
to create a high-quality image is well known, but with pseudo DRI, the trick is
to create the bracketing sequence itself from a single RAW source image.
This article explains how to turn this simple but effective idea into reality.

High Dynamic Range Imaging has been around for a while now, and pseudo HDR has become a popular technique since *Photoshop CS5* was introduced.

But the over-the-top, metallic bubble-gum colors produced by pseudo HDR techniques aren't everyone's cup of tea, and imaging experts are increasingly looking to traditional exposure fusion techniques to get the results they are looking for. An additional technique that seems an obvious choice, but which has still to be thoroughly explored, is to apply DRI techniques to artificially created bracketing sequences – i.e, pseudo DRI. The best program to use here is the *EnfuseGUI* freeware included on this issue's free DVD.

But first, let's take a look at the terminology we are using and what it actually means. The term Dynamic Range Increase (DRI) is often used rather vaguely to describe HDR and exposure fusion techniques. This article discusses exposure fusion, which is also known as 'blending' or 'merging'.

The basic idea is extremely simple. The 'best' pixels are selected from a bracketing sequence according to criteria such as exposure, the degree of saturation or the degree of local contrast. The second step in the process is to merge the image areas thus selected into a new image using selections with soft edges. The EV increments in this kind of sequence don't have to be of a consistent size (i.e., –2/0/+2) and can, for example, consist of images with values such as –3/–1/0/+2.5.

If you only have a single source image, you can also create a bracketing sequence using a RAW converter, which often helps to retrieve burned-out highlights or swamped shadows, especially in interior or night-time scenes.

The basis for our experiments is a single Camera Raw file with 10 to 11 stops of contrast. This is a dynamic range that pseudo DRI can use effectively to create images with the 8 EV (i.e., eight f-stops) of contrast that can be reproduced by most conventional monitors and printers. An interesting variation on this theme is to use panorama source images as the raw material for the bracketing sequence, as shown in our second example below. (jr)

Artificial Bracketing Sequences

Step 1

Image Preparation: It is quick and easy to create an artificial bracketing sequence from our somewhat pale looking RAW image using the Exposure slider in Adobe Camera Raw. For our example, we generated six source images with exposure values of –4, –3, –2, –1, 0 and +1, and saved them as 16-bit TIFF files. From the various programs available that are capable of performing the DRI process that follows we chose the *EnfuseGUI* freeware, which is available for download (for Mac and Windows) from software.bergmark.com/enfuseGUI. The program is extremely simple to use. All you have to do is drag your source images to the program window and click Enfuse It! We left all the other settings at their default values.
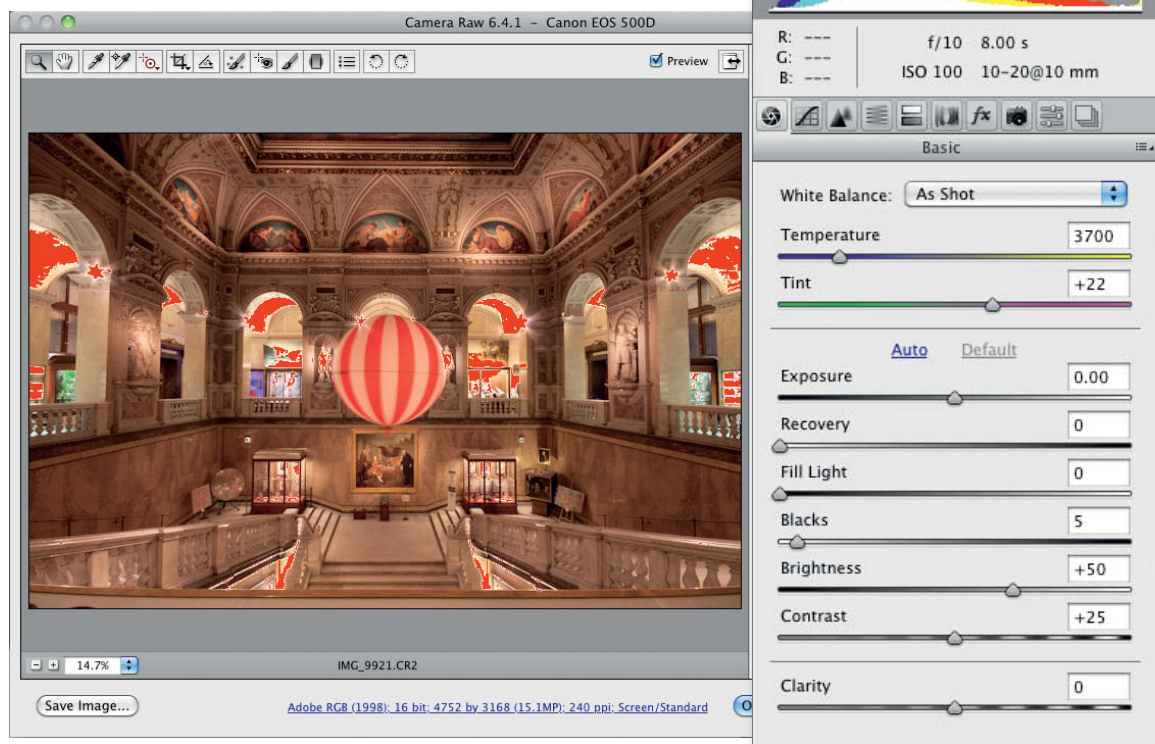
Step 2

Using EnfuseGUI: *EnfuseGUI* is provided with comprehensive documentation covering all of the program's functionality, which even includes noise reduction and focus stacking tools. The results are slightly too dark for our taste and require a little post-processing in *Photoshop*. Unfortunately, *EnfuseGUI* doesn't include auto-align functionality like its commercial cousin *LREnfuse* for *Lightroom*, although this doesn't present any problems for our purposes. If you are using a 'real' bracketing sequence, you can align your images in advance using the *Attempt to Automatically Align Source Images* option in the *Photoshop* File > Scripts > Load Files into Stack command. You can then use the File > Scripts > Export Layers to Files command to save your aligned images.
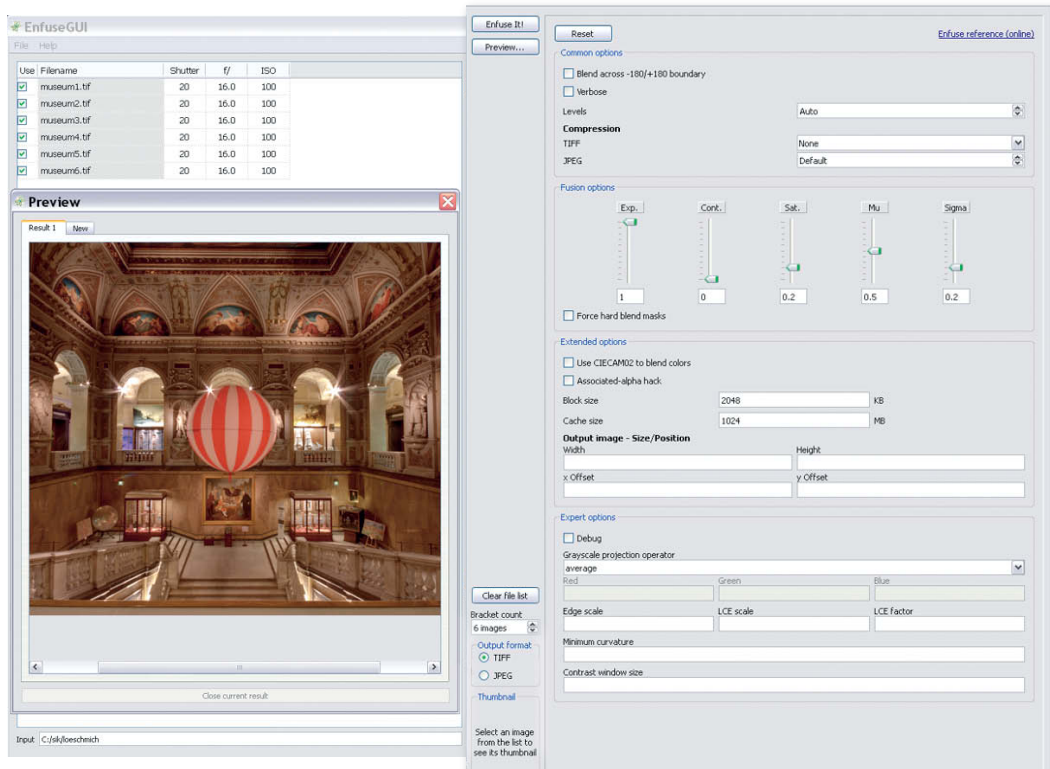
Step 3

Post-processing in Photoshop: We finished by performing conventional shadows/highlights, color, noise reduction and sharpening steps in *Photoshop*. To prevent the final image from looking too soft, we performed noise reduction using a mask to enable us to selectively reduce the effect for high frequencies. We used Peter Numratzki's free *Photoshop* Action to perform output sharpening. The result, printed on the first page of this article, is really very good, and is much more detailed and sharper than the original.
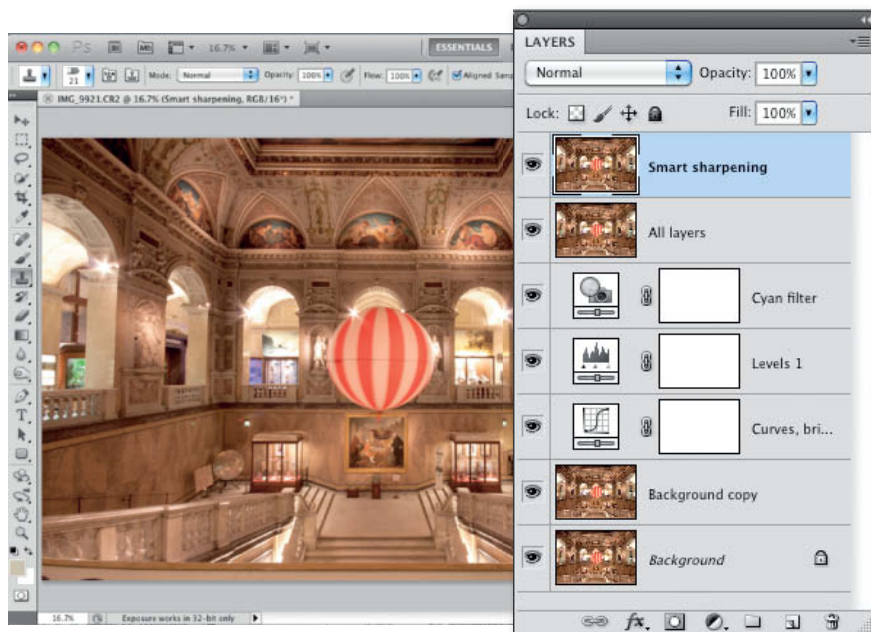
Pseudo DRI Panoramas

Step 1 **Using EnfuseGUI:** *EnfuseGUI* is well known as a standalone program but is, in fact, one of the original components of the *PanoTools* software suite. The *Hugin* version of *PanoTools*, with its graphical user interface, is not only capable of producing DRI images but can also automatically detect overlaps and control points in source images – a function that also works for artificially created bracketing sequences. The four source images in our example are of the Holbein Bridge in Frankfurt. We used *Adobe Camera Raw* to create an artificial -2/0/+2 bracketing sequence for each image.
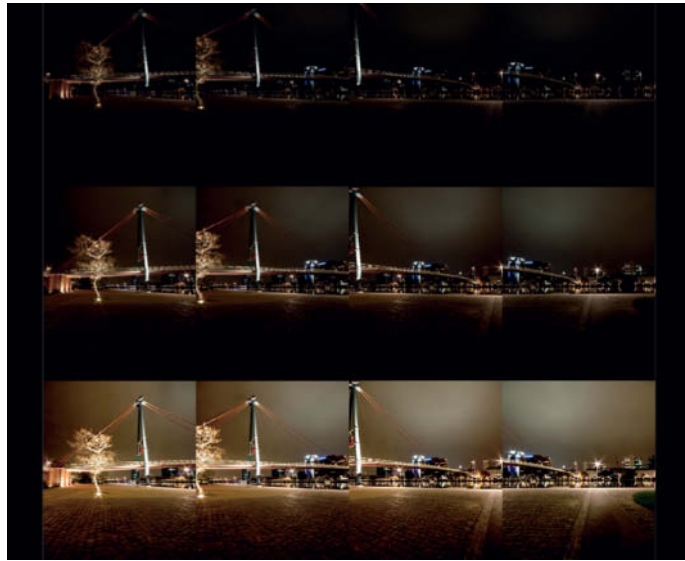
Step 2 **Using Hugin and EnfuseGUI:** Earlier versions of *Hugin* required the user to select control points manually, but the current version performs this task automatically. In fact, *Hugin* can set control points, perform distortion correction and start the DRI process fully automatically. The only manual setting we made was to switch the projection type to Mercator. If the source images are too dark, the Enblend merging engine can fail, so the solution here is to use E*nfuseGUI* to prepare the individual source images before loading them into *Hugin* for processing.
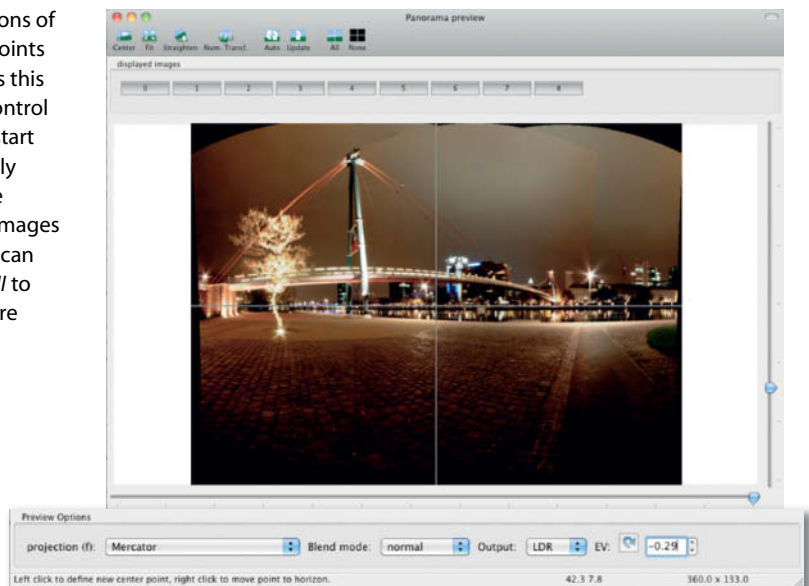
Step 3 **The Result:** Once again, we performed conventional optimization steps on our finished image, although in this case, we also cleaned up some of the joins between the source images and cropped the final image down to size. Again, the result is an image that has far more detail than the original and that we were able to create quickly and almost completely automatically.

Our conclusion: pseudo DRI techniques are great for moving subjects and situations in which you need to squeeze the very last drop of detail out of a RAW image file. Pseudo DRI TIFFs also make a solid basis for performing extreme dodge & burn or contrast adjustments on portraits.

Full Version Software

Xtreme Photo & Graphic Designer 5

Video Tutorial

Bert Monroy – The Making of Times Square

eBook

Painting with Light – Light Art Performance Photography

Image Processing Tools

easyHDR Basic
FDRTools Basic 2.5.1
Fotomatic 1.4
GIMP
GIMP Portable 2.6.11
GREYC's Magic Image Converter (G'MIC)
HeliosPaint 1.4.5
ImageMagick
ImageMagick Portable 6.7.4
LiveQuartz
Luminance HDR 2.2.0
Perspective Transformations 8.0

Phatch 0.2.7.1
Photomatix Pro
Photomatix HDR Presets
PSPI for GIMP
Raw Photo Processor 4.4.2
RawTherapee
Seashore 0.5.1
UFRaw 0.18
Wire Worm 6.1

Photo Tools

Enblend/Enfuse
EnfuseGUI 2.1.2
Exif Pilot 4.4
Exif Untrasher 1.4.3
ExifTool 8.76
HD View SL 1.2
MacPorts
WIA-Loader 1.7.1.0
WIA-Loader Portable 1.7.1.0

Sample Images

Camera Test Sample Images
Gigapixel Links

Christoph Kuenne

Pseudo HDR

Ever since photography was invented, creative artists have been looking for post-processing techniques that help them squeeze every last drop of detail out of their images. Pseudo HDR, the latest 'secret weapon' in this ongoing battle produces spectacular results with relatively little effort. Christoph Kuenne shows you how.

In this article:

It only takes a few minutes to convert a 'normal' photo into a hyper-detailed HDR image
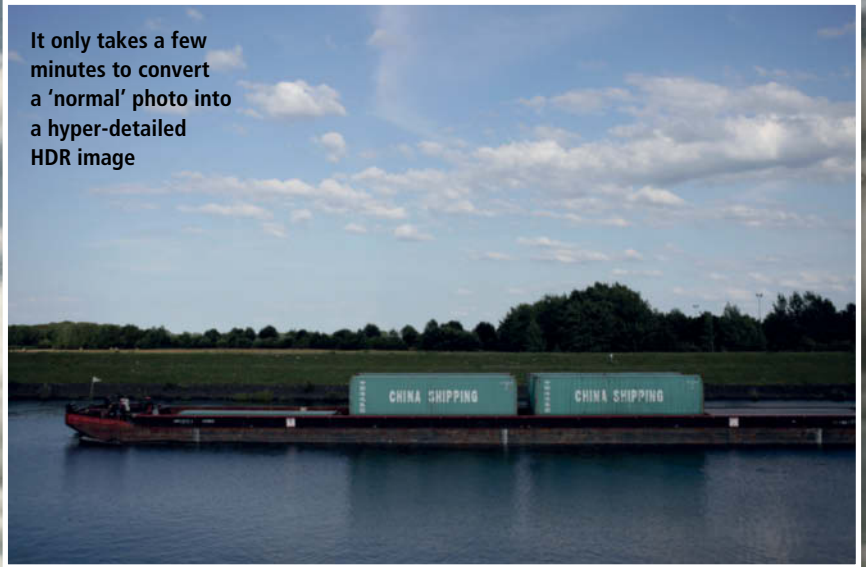
Every photographer wants an image to look just like the original scene at the moment the shutter was released. Unfortunately, this has never been easy to achieve, either using traditional analog film or modern digital image sensors. There are always details that leave something to be desired, especially if you view your images critically.

In tricky lighting situations that the camera cannot completely capture, you have to either select a particular detail that you want to expose 'correctly' or make multiple exposures that you can then blend into one

If you compare your photos with those of the old masters craft – Ansel Adams, for instance – you will probably be somewhat taken aback. These images were captured half a century ago but are still full of detail, form the brightest part of the sky to the darkest shadow. This can't be anything to do with superior technology, as today's equipment is generally better than that available all those years ago. You've guessed it: image quality is all about know-how.

Exposure

Let's start at the very beginning, before we even take a photo. The human eye perceives more contrast and detail than any available optical system and transports what it sees directly to the brain. This may seem miraculous, but is nevertheless a hard fact. When we take a photo of a scene, we first have to grapple with the subject's own contrast and set up our equipment to capture the greatest possible range of detail that the current state of the technological art allows. Cloudy days with relatively little, soft light are ideal for capturing maximum detail, but don't generally inspire most photographers to get out and get snapping. High-contrast scenes with brilliant colors, hard light and striking shadows are much more interesting. The range of brightness that such scenes display is often much broader than most cameras can capture in a single shot, and even the most sophisticated metering systems encounter serious problems trying to find the right compromise. The results are usually less than perfect, unless the photographer is well versed in manual exposure compensation technique. Today's high-end sensors can capture a dynamic range of about 10 f-stops, while mid-range models can capture between six and eight – a similar range to that accommodated by traditional slide film. Some analog film has a range of 14 or more stops if you know how to develop it properly. This equates to about one-and-a-half times as much detail as a modern full-frame image sensor.

Processing

Once a digital camera has captured an image, it saves it with 10-, 12- or 14-bit per channel color depth, depending on the capabilities of your hardware. This equates to between 1,024 and 16,384 different grayscale tones. This is, however, a theoretical maximum that is by no means achieved in every 14-bit image. Capturing images in JPEG forces the camera to use a maximum of 256 tonal values anyway. At a first glance, this doesn't appear to do too

much harm to the details and color transitions you capture, but the price of this false economy quickly becomes clear once you begin to apply complex processing steps to your images or convert them to the CMYK pre-press color space. This is when you begin to notice the artifacts and coarse transitions that require painstaking correction, in turn reducing the overall quality of the results.

If, however, you shoot in RAW format, the camera preserves every single tonal value captured by the sensor. It is only when you 'process' RAW images using a RAW converter that you once again begin to make compromises with regard to image quality. Most *Lightroom* and *Adobe Camera Raw* users save their developed image data back to a RAW file format and only use TIFF or JPEG when it comes to printing or applying processing steps that are not available within the RAW environment. For example, if you convert your RAW images using Phase One's Capture 1, the default output format for subsequent processing is TIFF. You can choose between saving your images to an 8-bit format with 256 separate tonal values or a 16-bit format with its (theoretical) 65,536

'Proper' Exposure

A great photo is based not on a good exposure, but rather on a perfect one. In other words, the essence of the subject is captured using a carefully considered combination of aperture, exposure time and ISO sensitivity. While such handicraft is becoming increasingly difficult to perform in these microprocessor-controlled times, the hard reality has not changed – details that are not correctly exposed will not be present in the final image. Many digital optimization processes serve to make bad images bearable, but the real aim of the exercise is to make good photos great. Anyone who wants to use pseudo HDR techniques to improve image detail should learn to expose correctly first. There are various approaches to perfect exposure, ranging from the use of a simple 18-percent gray card as a reference to comprehensive study of Ansel Adams' zone system. The latter is, of course, more complicated, but has the useful side effect of enabling you to see your subject(s) in a completely new light.

tonal values. If you use an 8-bit format, you are almost certain to lose some highlight and shadow detail. If, however, you select a 16-bit format, you will end up with image files that are twice as big, but which look identical when viewed on a monitor or printed. This is because most monitors can only display colors at 8-bit color depth and because the popular offset and inkjet printing processes are based on 8-bit systems. In the course of a normal digital image processing workflow, the 65,280 'invisible' tonal values saved in a RAW image file serve only to provide reserve data when you are applying complex retouching steps or to preserve detail in color-separated CMYK prints.

The fact that we are talking about something that our minds can conceive of but that we can rarely actually see does call the meaningfulness of the entire process into question. Most people's collections contain one or two images that would benefit from a little extra tonal range, but most images simply aren't of high enough quality to justify the effort. At least, this is what many people think until they begin to experiment with pseudo HDR techniques. The technical

The first step in making all of the detail captured in a correctly exposed RAW image visible is to convert it to 32-bit format

Tone mapping techniques can be used to view and print previously hidden detail
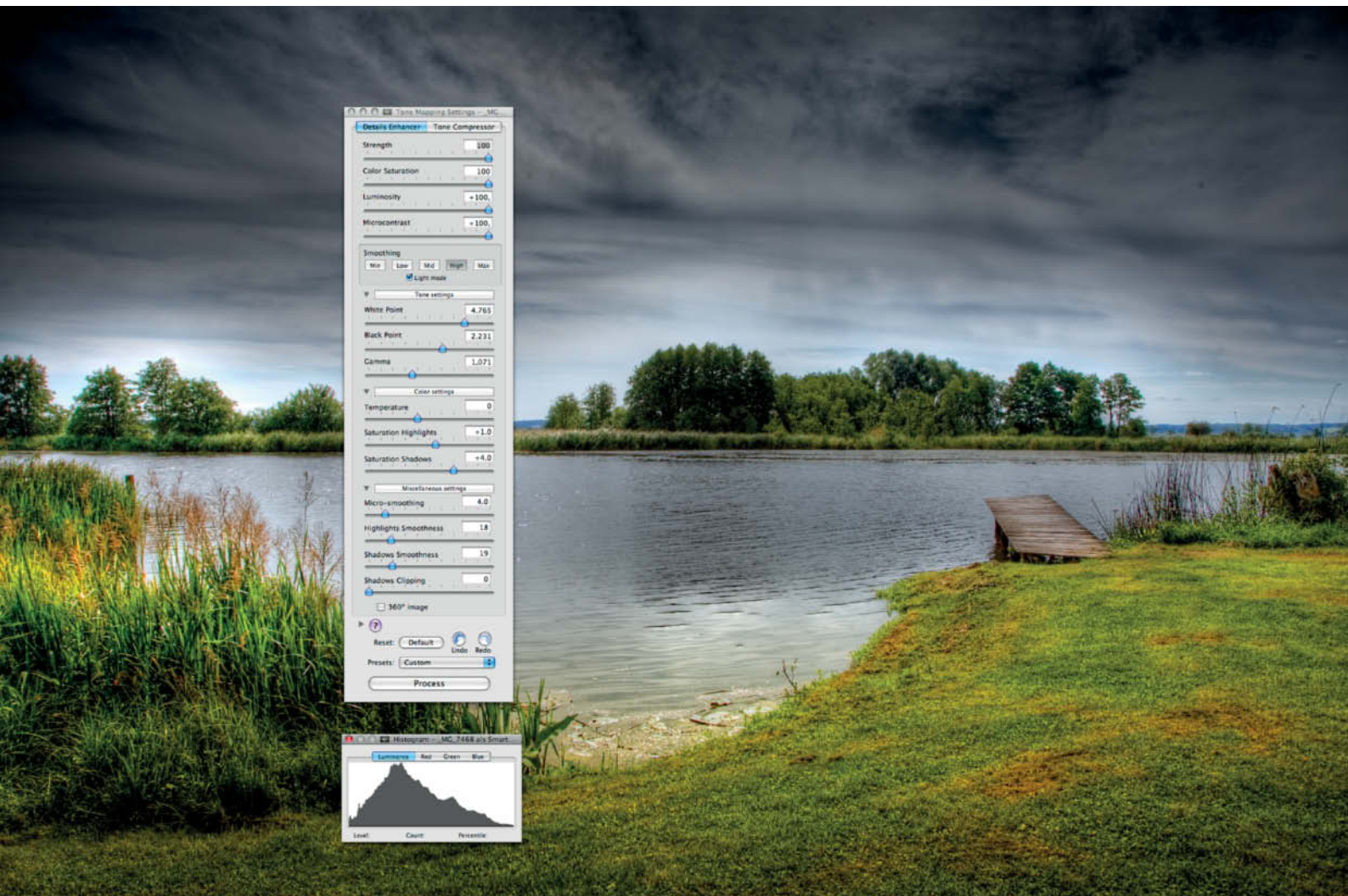
Ideal Source Images

Subjects shot in daylight under a cloudy sky that contain details that can be improved by enhancing their texture and surface patterns. Such images can end up as anything from abstract graphics to fine art prints.

Any image that contains clouds. Images like the one here that are exposed to emphasize the landscape benefit greatly from the increased cloud detail that the pseudo HDR process creates.

Images captured in the early morning or late evening that contain heavily saturated colors and soft transitions. But take care: the results tend to look kitschy if you don't moderate the strength of the effects you apply.

Sub-optimal Source Images

Source images with a dark overall mood are difficult to process because they often include details that emphasize an image sensor's weaknesses. The results will be anomalously obvious monochromatic noise artifacts or blocks of colored pixels.
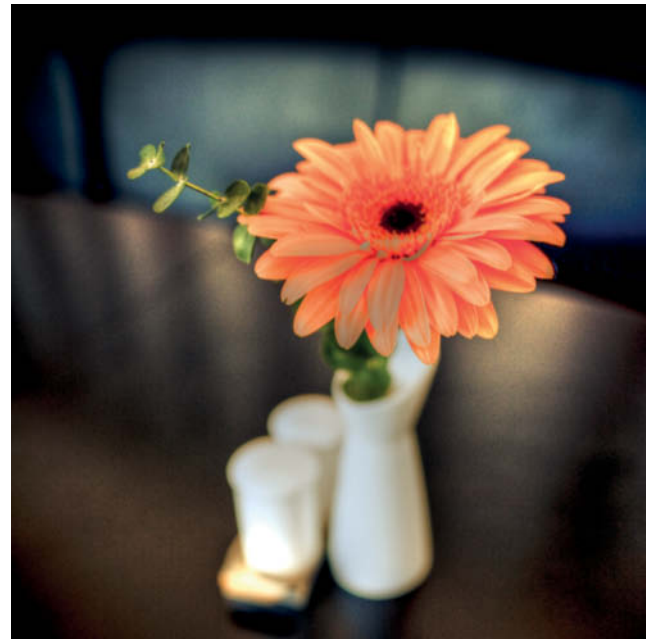
High-contrast details like those produced by strong sunlight or flash are the opposite of the type of fine art detail that HDR is designed to enhance and seldom benefit from this type of processing.

Artistically applied blur contradicts the ultra-high definition that HDR processes produce. Subtle HDR effects can enhance sharp details while leaving other, less sharp details untouched, but applying HDR effects to blurred image areas combines strong contrast with soft transitions, giving an image an inharmonious look.

side of the process is easily explained – instead of merging a series of differently exposed images into one single image with enhanced detail (i.e., an HDR process), pseudo HDR uses a single source image to achieve a similar effect. That may sound strange at first, as the process cannot, by definition, make use of any additional image data. However, on closer inspection, it does provide an approach that is theoretically capable of producing an image that makes all of the detail captured in a RAW image file visible. Technically speaking, what we do is develop our RAW source image in 16-bit mode and then convert it to 32-bit mode, giving it a total of 4,294,967,296 tonal values per channel. This doesn't create any new tonal values, but does give us raw material that we can now process using HDR tools. In other words, we can now perform dynamic range compression – otherwise known as 'tone mapping' – on our image.

Output

In this case, 'output' means more than just printing. Even if the technology involved is completely different, HDR images viewed on a monitor are subject to similar technical rules and limitations as they are when we print them. If you view an HDR image using a conventional image browser, it will not look particularly attractive. It is only when we view a magnified detail that the monitor can begin to display the full range of tonal values, and thus also the phenomenal amount of detail such an image contains.

The next step in the workflow is dynamic range compression, or 'tone mapping'. The best way to visualize what tone mapping does is to imagine a histogram that covers a range of over four billion tonal values and which contains just a few lonely looking tonal bars. Tone mapping compresses the entire tonal range and brings the existing tonal values closer together on the graph until they are all within the range of the 8- or 16-bit target color. The difference between this process and a conventional color space conversion is that here, more detail is preserved and smart compression algorithms ensure that the resulting tonal values are interpolated so that very subtle differences in tone are displayed with enhanced contrast. The resulting images appear to have been captured using ultra-sharp lenses under lighting conditions that lie somewhere between ideal and unreal. Whether your own results look more like graphic images or 'normal' photos depends

Tips & Tricks

RAW Development

If you use RAW conversion software as more than just a bridge between raw image data and editable image files, you are sure to ask yourself at some point whether it is a good idea to optimize your images before you tone map them. There is no simple answer to this question: if you want to maximize the potential of the tone mapping process, you should leave out any tonal value optimization steps (i.e., exposure and contrast correction) at the conversion stage. Adding and removing vignetting effects, color corrections and noise reduction are a different question entirely. If image quality is your major

priority, you should convert your RAW files using your software's default settings, tone map the results using *Photomatix*, save the results as a 16-bit TIFF and then fine-tune the results in *Photoshop*.

HDR and Scans

Technically speaking, it is possible to convert 16-bit scans to 32-bit mode and then tone map them. However, you should note that slide and Polaroid stock have a relatively narrow inherent dynamic range that cannot be enhanced using tone mapping tools. The same is true for scanned prints. However, things look slightly different for scanned negatives, as

they can contain as much as 14 stops of contrast that can be effectively enhanced using tone mapping. If you are planning to preserve your analog archives this way, you should bear in mind the enormous improvements in image sharpness that digital technology has given us. 35mm images from the 1980s and 90s often appear soft and lacking in detail to today's photographers, and tone mapped versions of the same images look equally unexciting. In contrast, medium- and large-format negatives have proved to be true treasure troves of hitherto hidden detail that simply begs to be digitally salvaged.

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on the settings you make during processing. Most HDR beginners tend to produce images with an over-the-top look, but tone down their approach once they have got to grips with the processes involved. These techniques are not only a great way to produce unusual looking images, but also a very effective image optimization option. HDR experts often produce a number of different versions of the same image and use *Photoshop* layers to blend them into a

completely new interpretation of the original image.

Once you have enhanced your image detail using tone mapping, you can print the results too. But remember that even the highest quality baryt prints – the reference used by most image quality fetishists – can rarely output more than 120 distinguishable tonal values, and most quality papers aren't capable of printing more than 80 or 100 grayscale tones anyway. Offset printing

processes have even less to offer. Even the big names like Ansel Adams didn't just expose their negatives using standard settings, but instead spent countless hours in the darkroom applying masks, dodges, burns and a thousand other tricks to bring out the detail in their prints. If these early masters had had access to today's tools they would probably have given praise to the powers that be and been much more productive than the technology of the time allowed.

'Real' or Pseudo HDR?

HDR purists are sure to claim that 'proper' HDR (i.e., HDR images created using multiple, differently-exposed source images) provides many more options and is generally a much better idea. However, there are various factors to be considered if you want to take the 'real' HDR route. Firstly, it is essential to work with a tripod, as all source images have to be perfectly superimposed. Secondly, the subject has to remain absolutely still during shooting, making HDR portraits virtually impossible and landscapes difficult, to say the least.

What all this means is that creating 'real' HDR images involves very careful planning and execution.

'Real' HDR is more useful for overcoming the challenges associated with tricky lighting situations, whereas pseudo HDR is perfect for using existing photos to create unusual effects – for example, if you want to simultaneously show an interior and all the details of the landscape beyond the window in a single image.
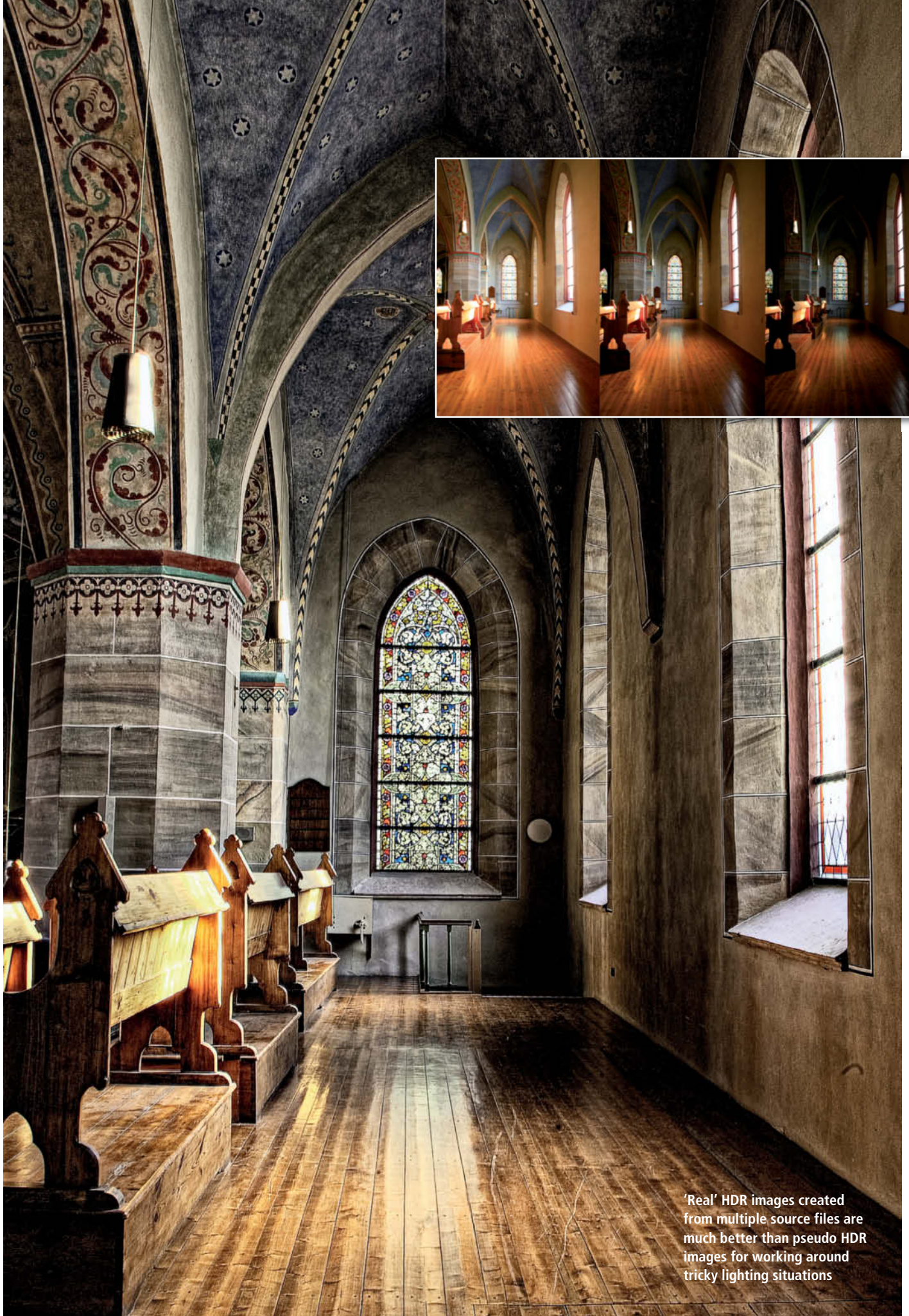
'Real' HDR images created from multiple source files are much better than pseudo HDR images for working around tricky lighting situations

Preparing Images for Pseudo HDR using the Photomatix Lightroom Plug-in

The simplest way to combine RAW development and Pseudo HDR in a single workflow is to use *Lightroom*, *Photomatix* and the *Photomatix* Lightroom Plug-in.
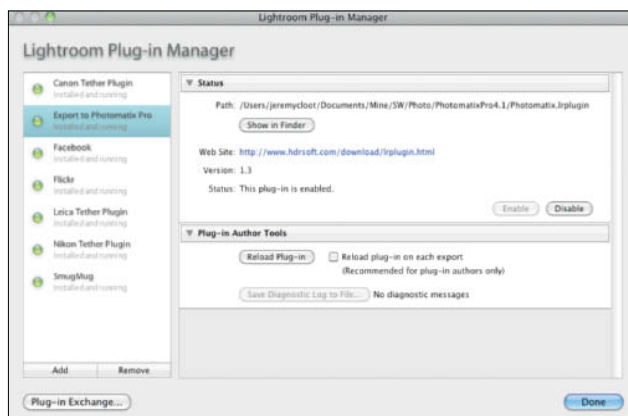
Step 1 **Install the Plug-in**
The *Photomatix* Windows installation routine automatically asks if you want to install the plug-in too, whereas on a Mac, you have to copy it manually to User/Library/Application Support/Adobe/Lightroom/Modules.

Step 2 **Activate the Plug-in**
Restart *Lightroom* and navigate to the Plug-in Manager in the File menu. Add the *Photomatix* plug-in and click the Enable button. Click Done to exit the plug-in manager.
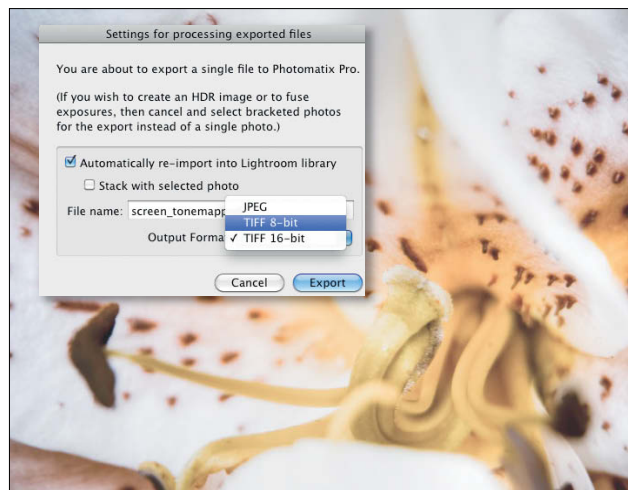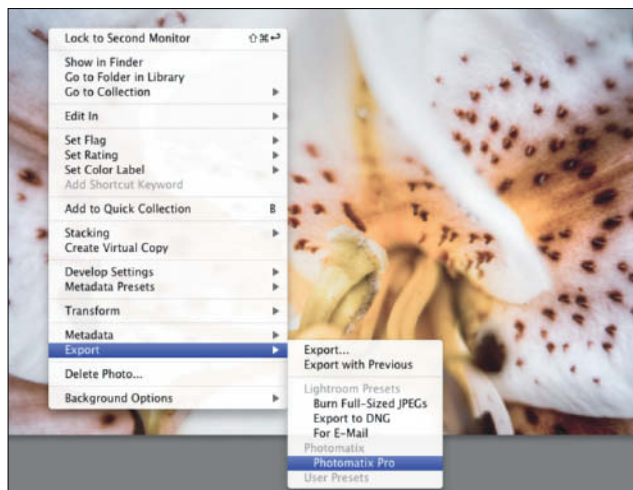
Step 3 **Export Your Image**
To export a single image, either select it and use the Export with Preset command in the file menu or the Export to Photomatix Pro command under Plug-in Extras. You can also use the Export command in the context menu.

Step 4 **Select your Export Settings**
You have to make three settings before you can export an image to *Photomatix Pro*. First, choose a filename (if you use an identical filename in a subsequent export run, your previous image will be overwritten without warning). You then have to decide whether to reimport the tone mapped image to *Lightroom* and which target file format you want to use. If you want to process the tone mapped file using *Photoshop*, select the 16-bit TIFF option.

Preparing Images for Pseudo HDR using Photoshop and Bridge

This approach is slightly more complex, but just as effective as the method described above. It involves *Adobe Bridge*, *Adobe Camera Raw*, *Photoshop* and *Photomatix* (provided you are not already using the *Photoshop* plug-in).
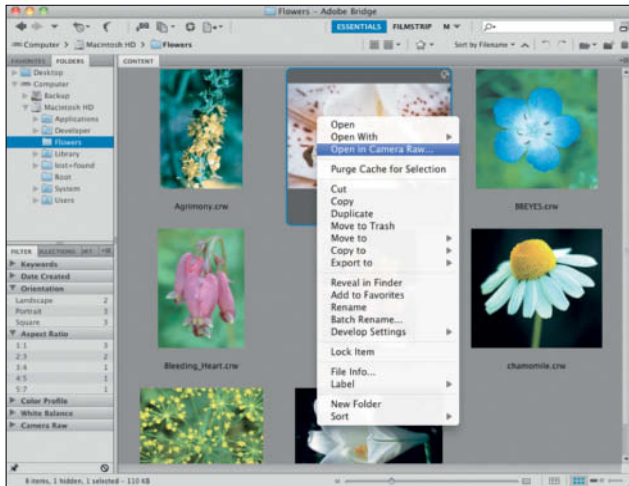

Step 1 **Open Your Image in *Adobe Camera Raw***
Select the image you want to tone map in *Adobe Bridge* and select the Open in Camera Raw command from the context menu.
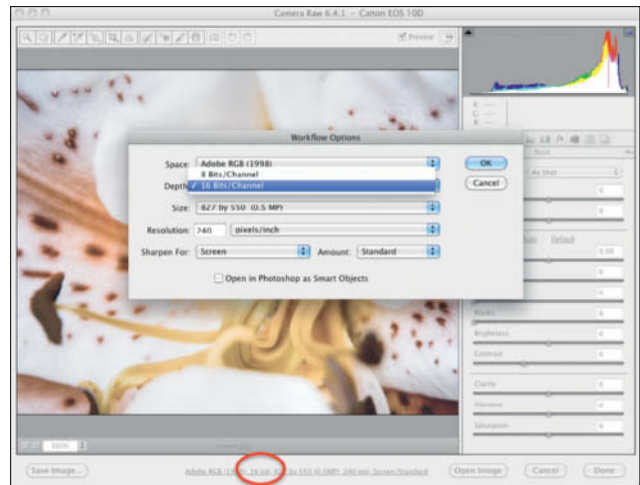
Step 2 **Activate 16-bit Output**
Check that the '16 bit' parameter is selected in the list of parameter sat the bottom of the *Camera Raw* window. To alter the setting, click the parameter and set the appropriate value in the Depth section of the Workflow options dialog.
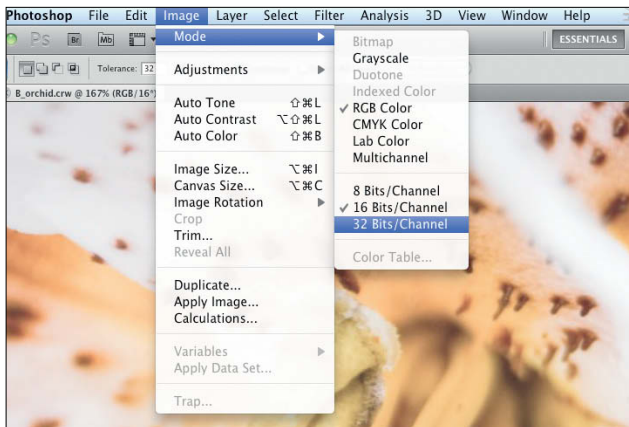
Step 3 **Convert to 32-bit**
Use the Image > Mode command to convert your image to 32-bit mode. This will have no visible effect, but will double the size of the image file.
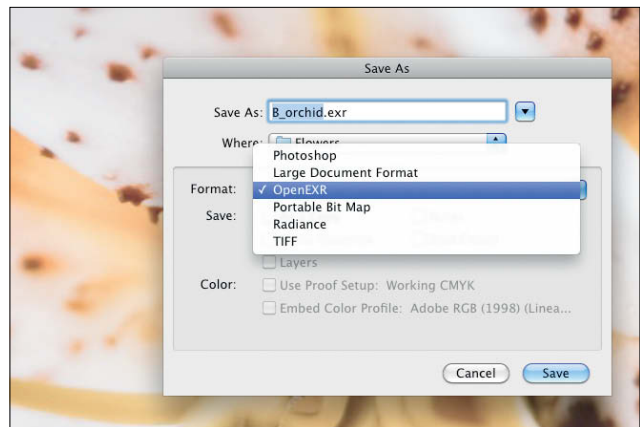
Step 4 **Save Your Image File**
Once you have processed your image, save the 32-bit file. There are various format options for 32-bit images, but when you are working with large files and you don't necessarily need to save multiple image states, using a specialized format like OpenEXR (.exr) makes your files easier to identify later.

Tone Mapping using Photomatix

We now have to convert all the fine tones from the high-resolution color space that the HDR process produces into an 8- or 16-bit format that can be adequately printed or displayed on a monitor. This tonal range compression process is known as 'tone mapping' and is designed to transfer as much of the detail contained in the image as possible to the available tonal range. The result retains all of the details captured by the original exposure and gives them extra emphasis. The resulting colors and apparent lighting look surreal, but nevertheless include an extraordinary amount of detail.
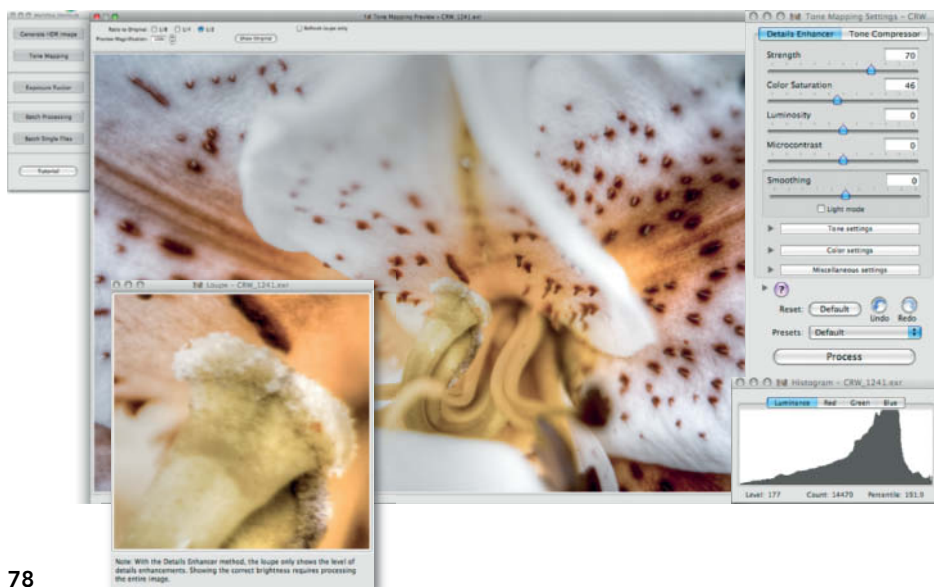
Step 1

Default Settings
Click the Tone Mapping button to begin processing. The keyboard shortcuts Ctrl+T (Windows) and Cmd+T (Mac) can also be used to enter tone mapping mode. The program's default settings have a visible effect on the shadow areas in our sample image. The preview image isn't always accurate, so check the effect of your settings using the loupe function if you are in any doubt.
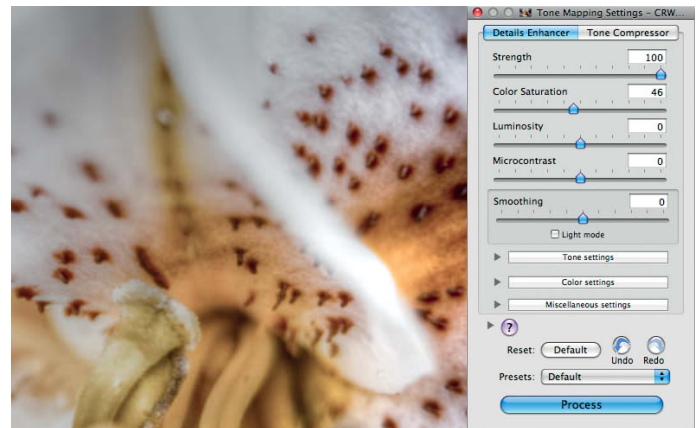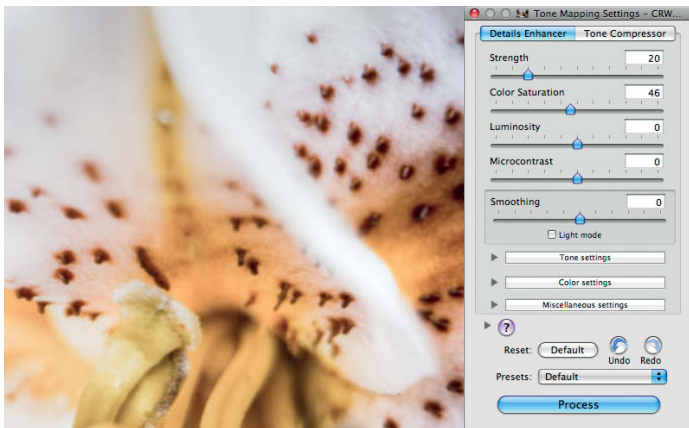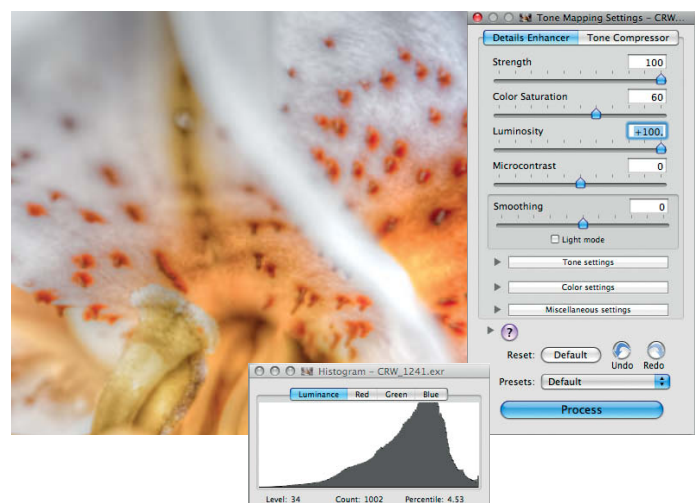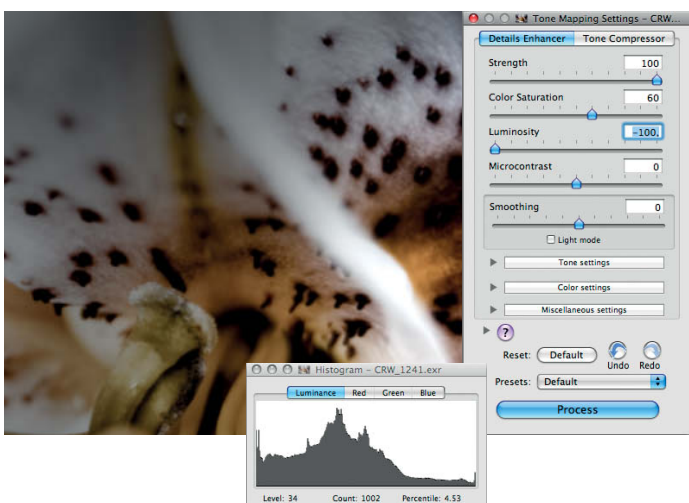
Step 2 Strength

The Strength slider effectively regulates the opacity of the overall tone mapping effect – i.e., the increase in global contrast. If you are looking to produce really creative effects, use a 100% value. Values of 30-50% are better for more natural-looking scenes such as landscapes, and 50-80% is a good starting point for processing architectural or night shots.
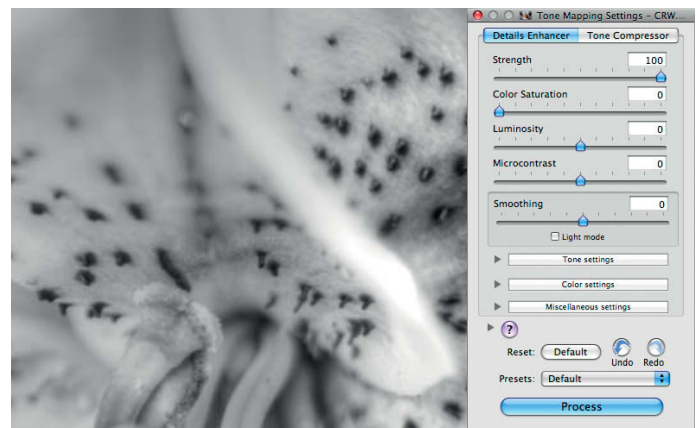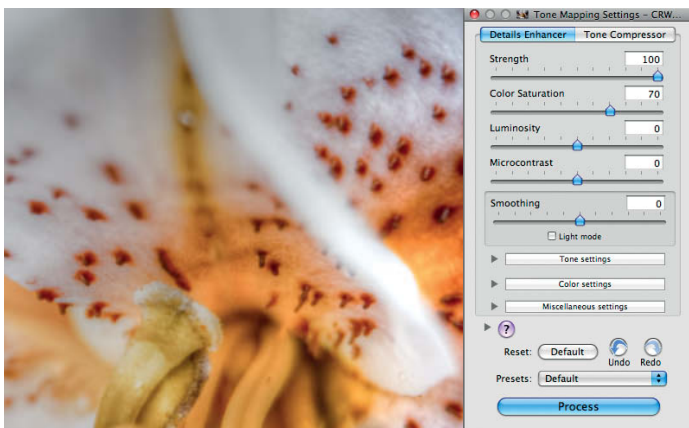

Step 3 Color Saturation

This slider has the same basic effect as its *Photoshop* namesake. Between 40 and 60% is a good basic range for the setting, whle 75% produces a high-colored, comic-like effect at the limits of viewing comfort. Generally, the setting you make will depend on the subject and your personal taste. Setting the value to zero produces a black-and-white image.

Step 4 Luminosity

This slider affects the brightness of the shadows and therefore indirectly affects the strength of the increase in contrast you produce. The greater the value you select, the brighter the image and the greater its detail contrast. The slider's effects are easy to follow in the program's histogram window.
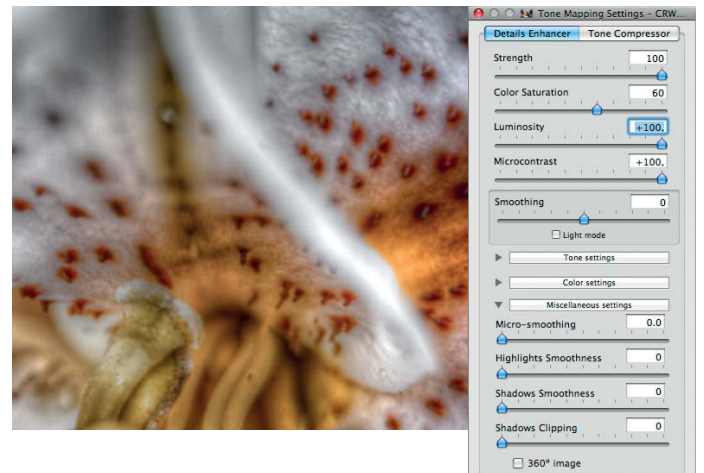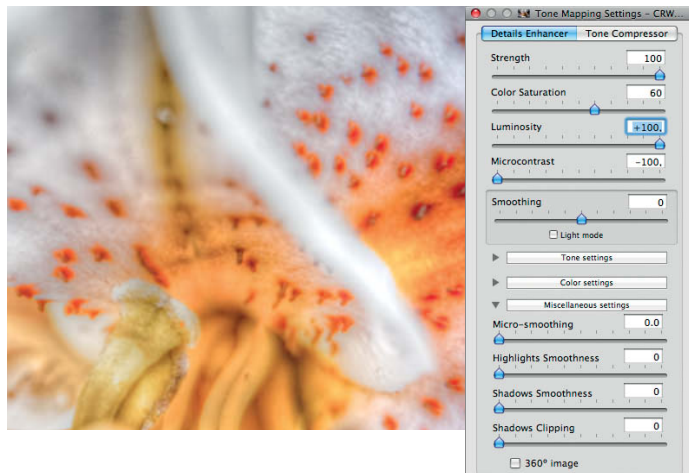
Step 5 **Microcontrast**

Tone mapping algorithms create their effects using local adaptation in a similar way to unsharp mask filters. What this means is that the effect is calculated on the basis of the relationship between a pixel and its immediate neighbors. The effect is controlled using four different parameter sliders that take both contrast effects and other aspects, such as camera-based artifacts, into account. For example, the Smooth Highlights slider can be used to reduce the effect of over-accentuated artifacts. Increasing microcontrast increases overall image luminosity in a similar way to an increase in brightness.
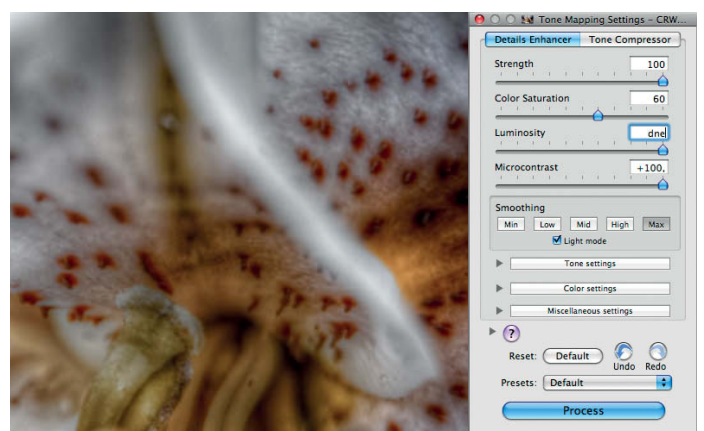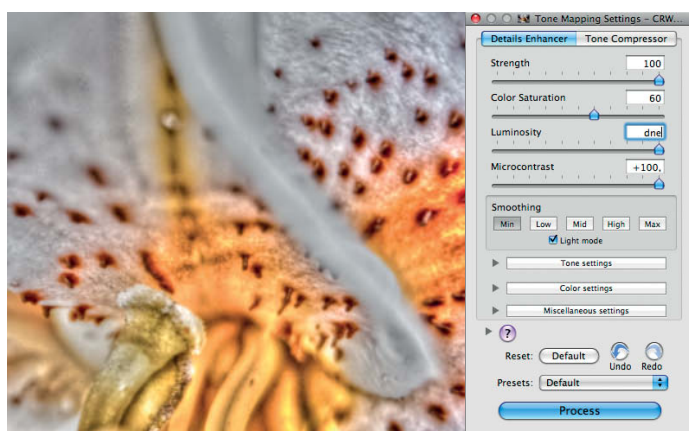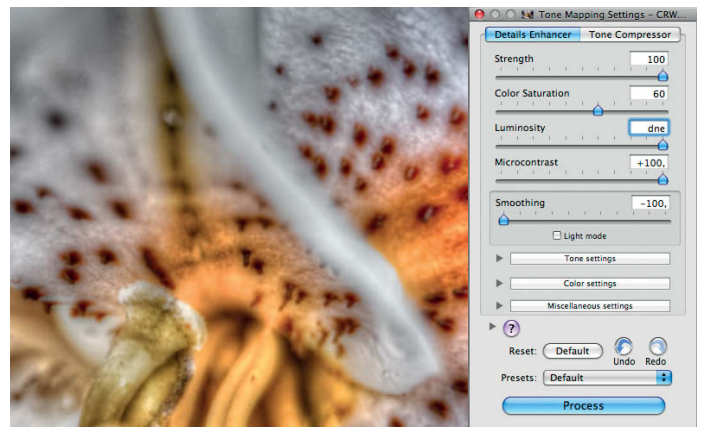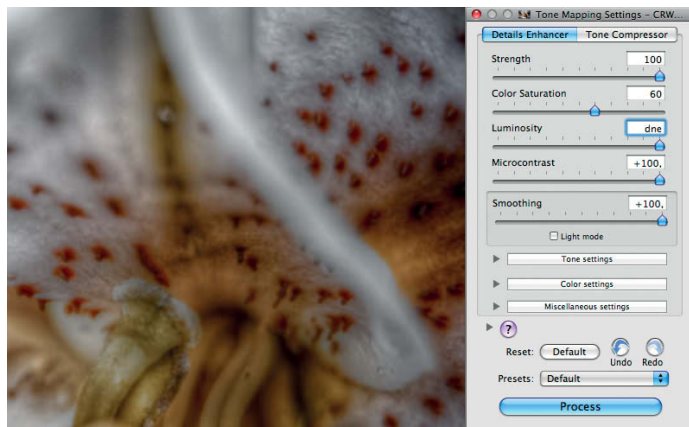
Step 6 **Smoothing**

This tool has two operating modes. Used as a regular slider, negative values increase overall contrast, while positive values flatten the contrast curve. The *Light Mode* option produces effects ranging from typical HDR to relatively over-the-top using five preset buttons. 'Mid' and 'High' are the best to use for general-purpose contrast optimization.
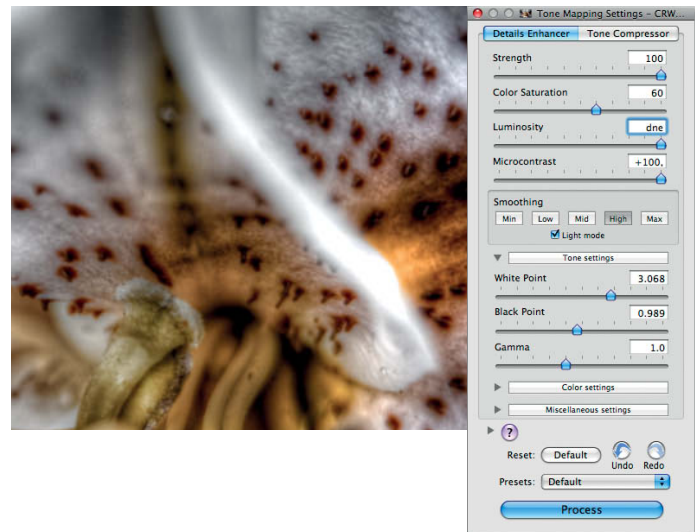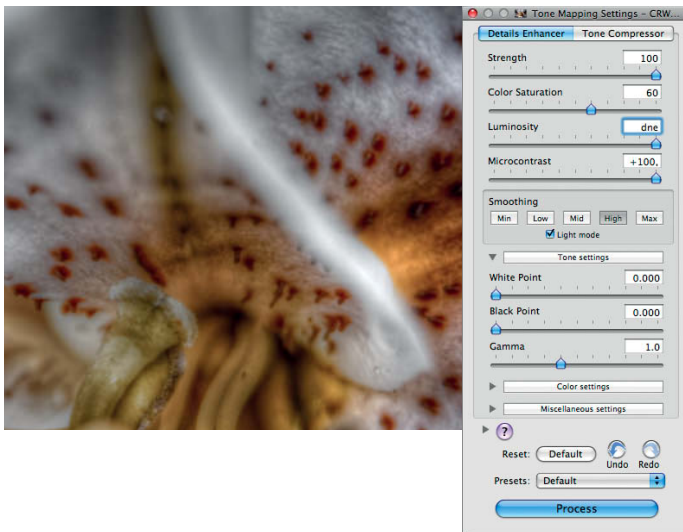
Step 7 **White Point and Black Point**
These sliders determine the points at which shadows begin to lose detail and highlights begin to white out, similar to the way the *Photoshop* Auto Levels tool produces a balanced overall look in an image. The values you use will depend on the subject and the type of effect you want to produce. If you leave both set to zero, your image will be full of midtones but will have no genuinely white or black areas.
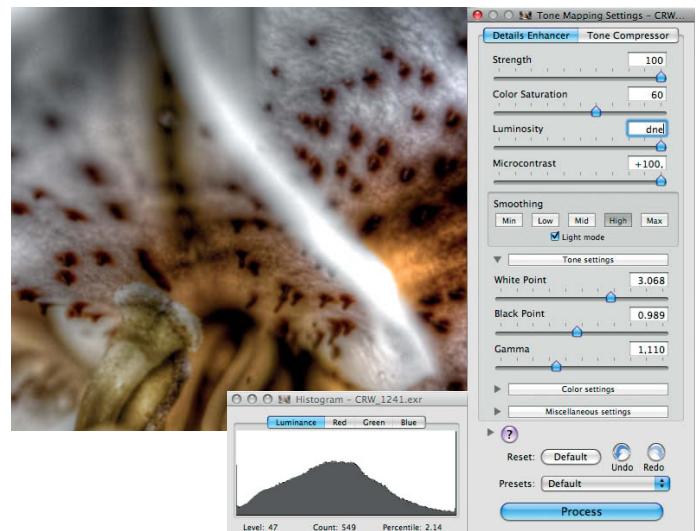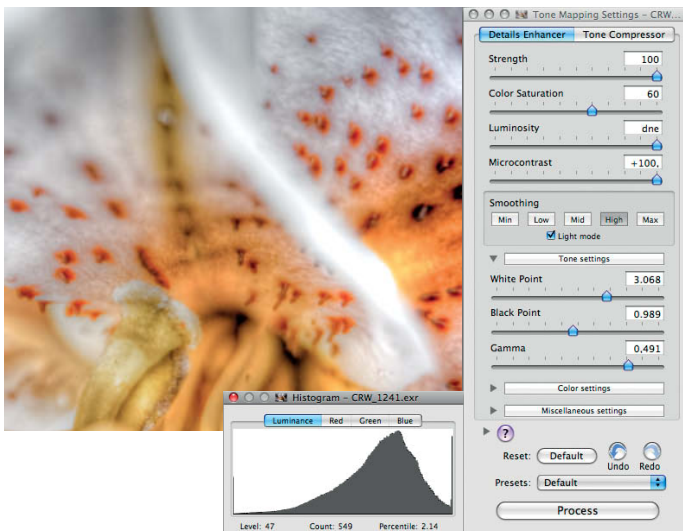
Step 8 **Gamma**
The Gamma slider produces similar effects to its *Photoshop* counterpart, and determines midtone color values. It is useful in the current context if processing produces a marked midtone shift in the histogram curve. Technically speaking, this type of shift is not necessary for our sample image, but could nevertheless be useful as a reference point during fine-tuning. Once you have made all your settings, click the Process button to apply them.

Software Selection

HDR Software is available from various manufacturers in a wide price range.

In principle, *Photoshop*, too, can create HDR images from single or multiple source images, although the program's tone mapping functionality is – to put it politely – fairly limited. The same is true of most of the freeware tools we have tried.

Photomatix Pro costs US$99 and offers excellent tone mapping tools. The program also includes 32-bit converion functionality, although we recommend that you leave this part of the process to *Adobe Camera Raw* (the conversion engine used by *Lightroom*) or Phase One's *Capture 1*, as both produce much more reliable results.

Since the release of the 3.0 version, *Photomatix* also includes a *Lightroom* plug-in with direct export functionality, but with an overall feature set that doesn't match that of the standalone program.

Using Photomatix Presets

Pleasant as it is to have such a wide range of options (we have, by the way, only touched on about half of those available), they do make working selectively and efficiently with *Photomatix* quite tricky. To help you get started, we have built a set of exclusive presets that you can find on this issue's free DVD.
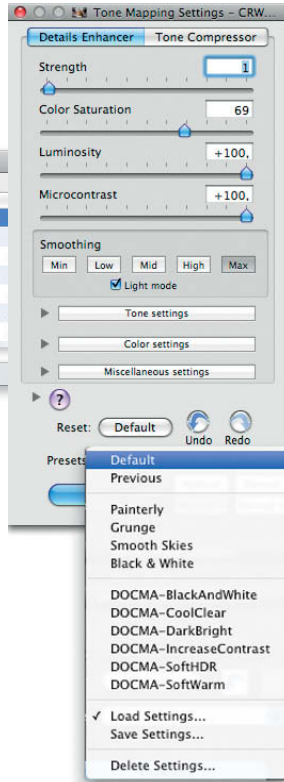
Step 1 Install Your Presets

All you have to do is unzip the presets_english.zip file and copy the XMP files contained in it to the User/Library/ApplicationSupport/Photomatix/Presets folder (Mac) or to C:\Programs\PhotomatixPro\Presets (Windows). Then restart Photomatix and load an image. Your new presets are located in the Presets drop-down in the Detail Enhancers view.

Step 2 The Original Image

A photo that displays the typical characteristics of automatic exposure control. The sky is uninteresting and the main subject lacks detail. A typically hazy day in northern Germany.

Preset 1 IncreaseContrast

This preset basically bundles the settings discussed in our workshop above, and provides a great starting point for accentuating detail rendition in the sky and intensifying the colors.

Preset 2 BlackAndWhite

This preset completely desaturates all the colors before slightly increasing the contrast to produce a fairly dark mood. Try making adjustments to the program's Tonal Settings to fine-tune the effect.

Preset 3 SoftWarm

This preset produce soft, warm light by moderately increasing contrast while giving color saturation a boost.

The Problem with Human Subjects
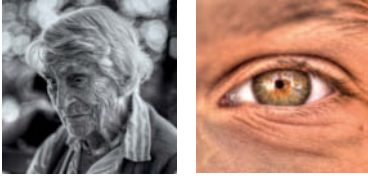
Photos of people are difficult to enhance effectively using pseudo HDR techniques. People of all ages are seldom happy to have their skin texture accentuated in a photo. Pseudo HDR treatment emphasizes wrinkles, patchy tanning, liver spots, blood vessels and just about any other skin imperfection – in other words everything that we usually try to conceal in a portrait. Applying HDR processes to a portrait often makes a person appear more distinctive but seldom makes them appear more attractive.

From a Negative to a Print

Even if the comparison appears slightly outdated, an analog darkroom is the best place to envision the difference between the image captured by the camera and the one that ends up in print. If you inspect a negative using a magnifying glass you will be able to see details that hobby-level techniques simply cannot reproduce in a print. Printing is a constant compromise and forces the photographer to decide between a range of print versions that show either one or other set of details. Basic dodging and burning techniques can, theoretically, help to enhance the odd detail or two, but conventional darkroom techniques nevertheless appear almost laughable compared with the options available in today's 'digital darkroom'.

Original negative   Print from negative   Scan from negative

Preset 4   **DarkBright**
Strong saturation, reduced brightness, a high black point setting and strong microcontrast give this preset its unique, stormy look.

Preset 5   **CoolClear**
With its desaturated colors and low microcontrast, this preset creates a detailed look. It is useful not only for producing interesting visual effects, but also for checking the processing potential of source images.

Preset 6   **SoftHDR**
Lots of detail and surreal colors are the key elements of HDR images, and this preset tests these to their limits. If you add the *Min Light Mode* option to the mix, you will begin to test the limits of good taste.

Tonemapping using Legacy Versions of Photoshop

The HDR tools included with earlier versions of *Photoshop* (up to CS4) appear slightly lame compared with the options offered by *Photomatix*, but are nevertheless a useful addition to any photographer's arsenal. To activate the HDR Conversion dialog box, simply switch your 32-bit image to 16-bit mode and choose one of the following methods:
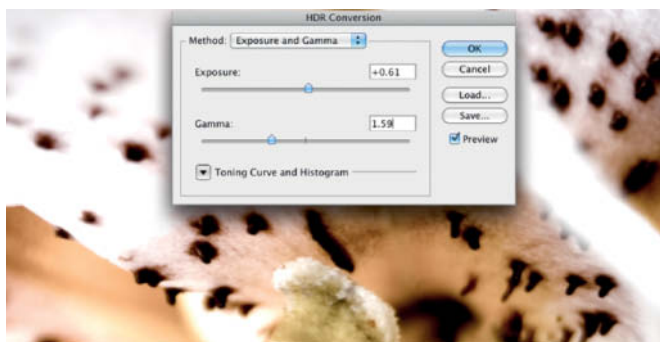

Step 1 · Exposure and Gamma

This method is reminiscent of the rightness and contrast settings that many photographers like to apply to their photos. Reducing the gamma value produces a distinctive, hard lighting mood. Extreme care is required when altering the Exposure setting.
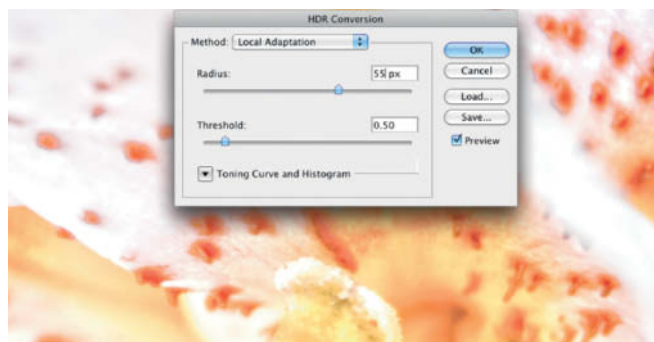
Step 2 · Local Adaptation

This method gives you the most options for influencing the final look of your image. There are sliders for adjusting the Radius and Threshold tone mapping values. Extreme settings produce fringing at high-contrast edges. If you activate the *Toning Curve and Histogram* option, you can use a fully functional tone curve to fine-tune contrast as you would using the conventional Curves tool.

Step 3 · Equalize Histogram

This method balances the image histogram without further user input and produces a useful compromise between the type of highlight detail produced by method **2** and the effects of the reduced gamma value suggested in method **1**. The result is often the most interesting of all the tool's graphic effects.
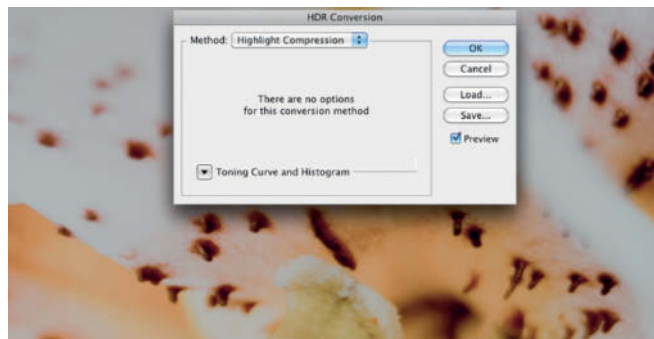
Step 4 · Highlight Compression

This method produces highly accentuated highlight detail while suppressing midtone and shadow contrast. It is perfect for use with images like our sample because it compresses all tonal values to within a usable 8-bit range and enables us to fine-tune the resulting image using just a couple of tweaks with everyday *Photoshop* tools.

Pseudo HDR without RAW Source Material

Tone mapping techniques often improve JPEG image files very effectively, but they also increase the risk of amplifying previously unseen noise and compression artifacts, because compression algorithms often remove as much as 80 percent of the original image data. Remember, too, that it is impossible to make any additional tonal values visible in an 8-bit image (regardless of whether it is a JPEG or a TIFF) by saving it in a format with greater bit depth. The only exceptions in the context of pseudo HDR images made from RAW source material are 16-bit scans of negatives and 16-bit TIFFs recorded directly in-camera.

Photoshop CS5 and HDR

Until recently, the *Photoshop* HDR module was a rather fiddly, 'technical' tool, but Adobe's developers have finally realized just how important the functionality is to today's photographers and have given the most recent version a whole new range of creative options.

HDR Toning

The good news for all detail fans is that *Photoshop CS5* has a new, built-in pseudo HDR dialog that you can use to HDR-ify just about any image. This basically equates to pure gimmickry when processing 8-bit JPEGs, but really comes into its own if you want to squeeze the very last drop of contrast and detail out of your 16-bit RAW files.

In addition to the three better-known and less flexible conversion methods, the Local Adaptation method now includes no less than seven individually adjustable parameters for enhancing detail and adjusting exposure. Because the tool automatically converts images to 32-bit mode before saving them back to 16-bit mode during the tone mapping phase, the effect can only be applied to flattened image files – i.e., it doesn't work with layers. If you want to apply it to a multi-layer image, you will first have to make a flattened duplicate that you can copy back into the original document once you have processed it. You can then selectively apply the changes you have made to contrast using layer masks. This tool isn't as flexible or powerful as specialized software like *Photomatix Pro*, but its high degree of integration with the rest of the *Photoshop* environment makes it a much more persuasive option than its predecessor versions.

Merge to HDR Pro

Support for 'real' HDR functionality (i.e., merging multiple, differently-exposed
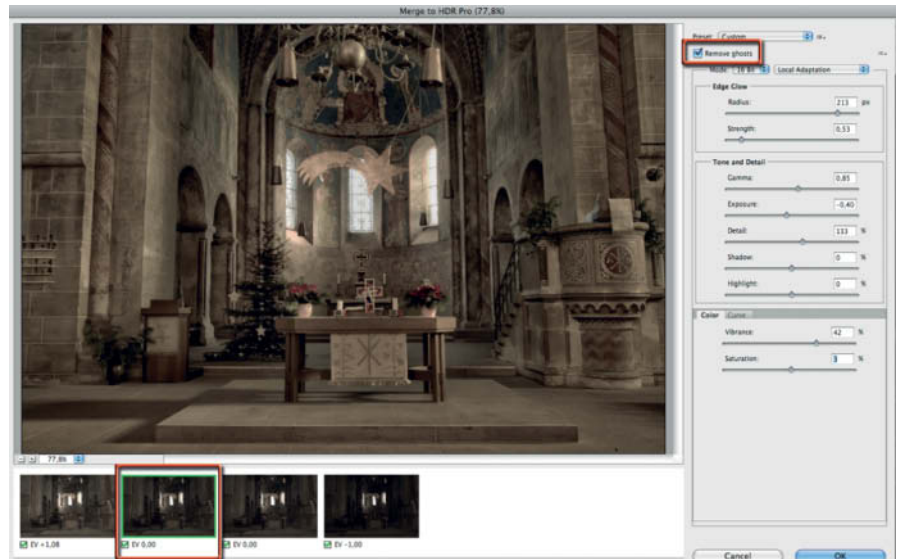
The *Remove Ghosts* option in the Merge to HDR Pro dialog automatically removes unwanted artifacts caused by parts of the subject moving between shots

images in 32-bit mode) has also been improved. Here too, you can apply all the new adjustments found in the Local Adaptation dialog. Not only that, but the new tool also includes the *Remove Ghosts* option, which automatically detects and removes the ghosting caused by objects that move between shots. The option lets you select which image to use as your reference and uses general detail, but no high-contrast

edges, from the others in the final, merged image. If you have the opportunity, merging high-resolution RAW images to HDR is a great way to test the added speed of the 64-bit version of *Photoshop*.

The HDR Toning command lets you apply the full range of HDR contrast and exposure settings to individual (flattened) images
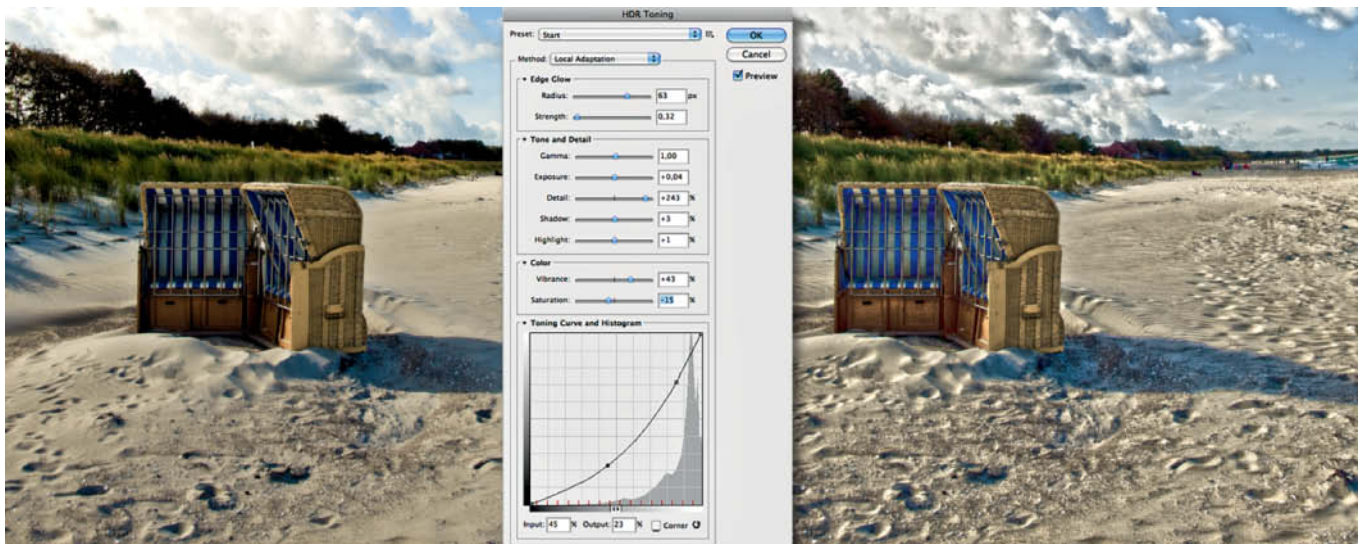
HDR Glossary

The HDR world is full of specialist terms and buzzwords that are often defined differently, depending on their source. This section explains the most important ones.

HDR

HDR stands for 'High Dynamic Range' and describes a process that merges multiple images shot using differing exposure settings. The result is a single digital image that displays a very large range of contrast at full detail. Conventional digital images with less dynamic range are sometimes referred to as 'Low Dynamic Range' or LDR images.

Pseudo HDR

Pseudo HDR describes a number of processes that use a single source image to produce similar visual effects to 'real' HDR processes. In addition to the techniques described in this article , another popular method is 'exposure blending', which blends multiple images into a single image using layer and custom layer mask techniques.

Dynamic Range

In a digital photographic context, the term dynamic range describes the maximum contrast ratio (i.e., the difference between the brightest and darkest parts of an image) that the film or image sensor can capture. The extreme ends of the scale are represented by absolute darkness and very bright sunlight. The human eye adapts to these differences by opening or closing its pupil, while a photo camera uses an iris aperture to simulate the same effect. A large range of contrast produces greater sharpness, but there is currently no technical apparatus available that can capture the entire range of contrast present in nature. This makes it necessary to reduce the dynamic range of an image before saving it. Dynamic range is usually measured and stated in terms of f-stops.

Tone Mapping

Tone mapping is a process used to compress the range of tonal values in a 32-bit HDR image. It reduces the contrast ratio of the HDR image in order to make it possible to display or print it using conventional output devices.

Color Depth

Color depth describes the maximum number of tonal values that a device such as a digital camera, a monitor, a scanner or a printer can capture and/or display. Color Depth is stated in terms of bits and can be calculated using the simple formula 2^x. Image color depth is generally stated in terms of bits per color channel (i.e., 8, 12, 14, 16 or 32), whereas device manufacturers tend to state it in terms of the overall sum of the available bits (i.e., 24, 36 or 48).
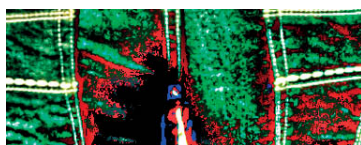
Artifact

This is a general term that describes image errors produced by sensor noise, compression algorithms or extreme color saturation. Artifacts are usually visible in the form of unexpected pixel patterns or inconsistent colors.

Color Errors

Ideally, the transitions between areas of varying colors in an image will be smooth and unobtrusive. Heavy image processing can, however, cause a reduction in the number of visible tonal values and a consequent increase in unwanted edges, artifacts or pixelation in places where smooth transitions were previously visible. (jr) **c't**

The author says:

"Once you have tried out pseudo HDR techniques once, you are sure to want to apply them to all of your RAW images and extract new treasures from long-forgotten corners of your archives. If you have enough computing power on hand, you can use presets to take the guesswork out of the tone mapping process and turn HDR conversion into a quick and reliable way to give your images extra polish."

Quick and Dirty Pseudo HDR

If tone mapping artificial HDR data seems too complicated a way to gain a little extra image detail, *Photoshop* offers simpler ways to achieve similar results. The Shadows/Highlights command in the Image > Adjustments menu alters image contrast by individually adjusting detail rendition in the shadow and highlight areas. Most RAW converters (including *Adobe Camera Raw*) also have separate highlight and shadow adjustment sliders that you can use to produce similar effects.

Adobe Camera Raw **offers various ways to directly improve the dynamic range of an image**
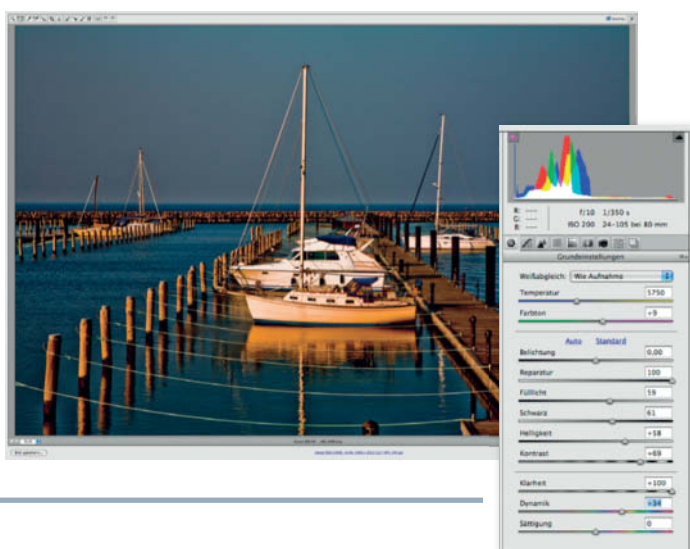
EXTEND YOUR VACATION!
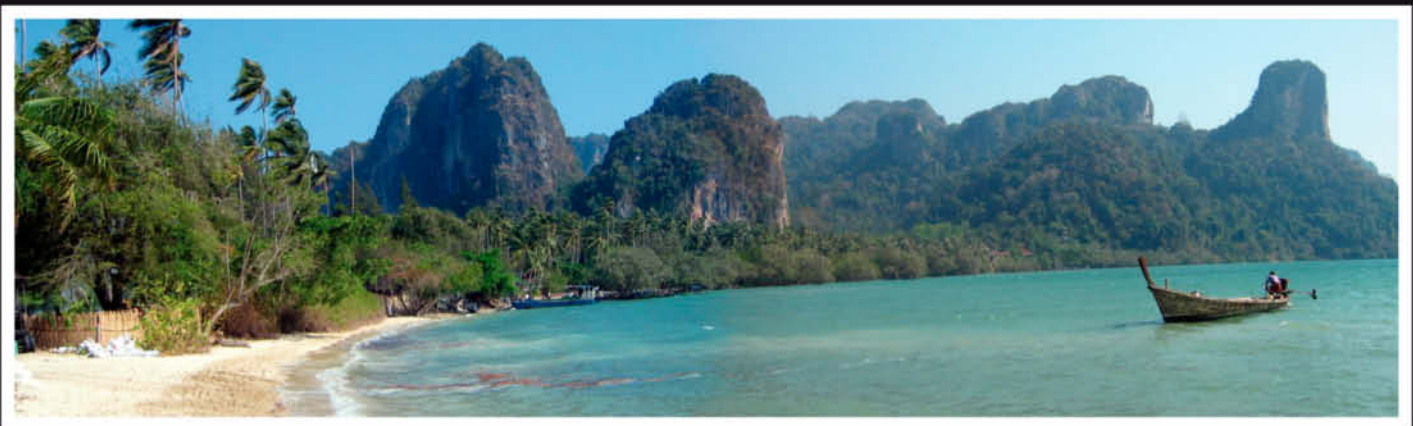
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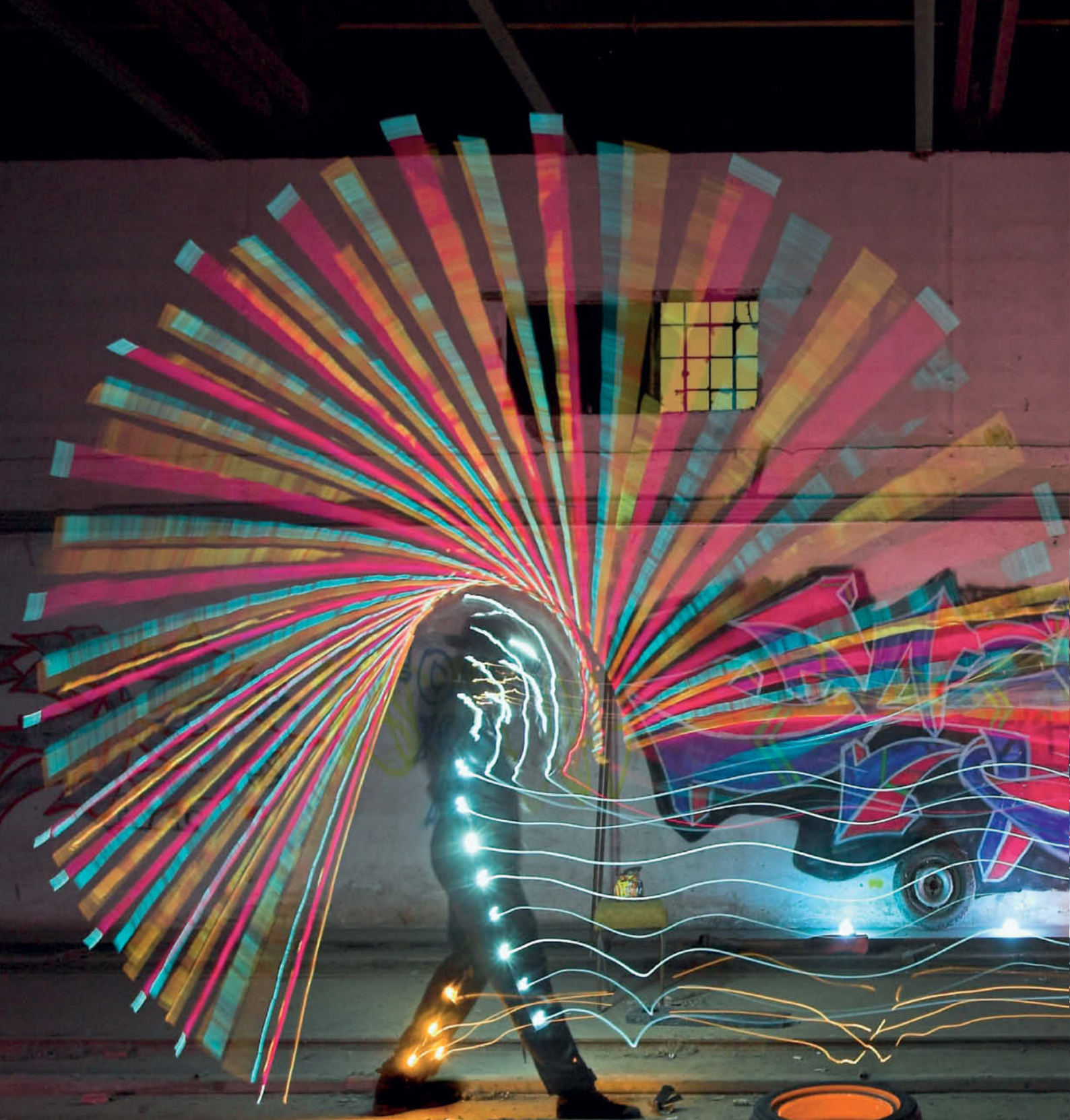
JanLeonardo Woellert

Dances with Light

Even in this digital age of rapid and endless change, the art of creating images using continuous light sources and long exposures is constantly gaining new devotees. This unique symbiosis of photography and light art performance is a hot new trend, and is just beginning to develop beyond its infancy. This article takes a look at the origins of the genre and the techniques used to produce these fantastic images.

Summer 2007. One warm July evening I got myself locked into an industrial warehouse. This unintentional confinement turned out to be a happy accident, as I ended up using the time to experiment with my gear in the dark. One of my floodlights left a broad, bright trace on the sensor as I adjusted its position during a long exposure, and the notion of combining light art performance with photography was born.

In the following weeks, I spent every spare night-time minute experimenting with my lights and my camera. The 'light ball' that so many light painting beginners like to imitate was one of the products of this early phase, as was the 'Light Man' suit – an overall with chains of LEDs attached that light up to follow the silhouette of the person wearing it.

After several weeks of trial and error, I managed to produce my first worthwhile results. As my ideas and concepts became increasingly complex, I began to have difficulty shooting them alone. When I showed my work to Joerg Miedza, a photographer friend, he was fascinated right from the start, and it wasn't long before we started creating new projects together.

Three months later – in September 2007 – we launched the LAPP-PRO.de project and began the metamorphosis that produced today's Light Art Performance Photography, or LAPP, as we call it. Our images quickly gained popularity at sites like fotocommunity.de and flickr.com, and later at our own site, www.lapp-pro.de. In December 2008, we also won the German national science photography prize.

There followed commissions for Nike for the soccer World Cup in 2010, Diesel apparel and publishers Burda and Gruner & Jahr. Our book, *Painting with Light*, was published by Rocky Nook in May 2011.

Choreographed photography has since become a tangible trend, and Flickr and Facebook have their own dedicated light art groups (called Light Junkies at Flickr). Some of these groups have as many as 9,000 members and are extremely international.

Photography in the Dark

The first known experiments with photography in the dark were conducted by American

photographer and gallery owner Alfred Stieglitz in 1893. Stieglitz was one of the first photographers to treat shooting in the dark and 'freezing' a subject's movements as an art form.

Nevertheless, the first serious attempts at night-time photography did not take place until the 1920s and 30s.The real breakthrough came in 1922, when Brassaï (real name Gyula Halász) published his book *Paris de Nuit* (Arts et Métiers Graphiques), which was packed with images of the 'seedy' side of Paris nightlife.

Alan Delaney, William Lesch, Jan Staller, Steve Harper and Shimon Attie are just some of the big names who paved the way for modern night-time photography and light art.

The advent of digital technology and the ability to check results immediately opened up the field of night-time photography to the masses. In analog times, you not only had to wait to see your results, but also had to pay for every single frame or slide you shot, whatever you ended up capturing. Digital cameras make shooting simpler and accelerate the learning process enormously. With a little creativity and imagination, a photographer can quickly produce really interesting results, which is one of the reasons why night-time photography has become so popular. Another reason is the attraction of portraying familiar objects in a new light. No other form of photography gives the photographer such a far-reaching opportunity to get actively involved in the image capture process or to capture so much dynamism and activity in a single photo. No doubt you are familiar with artificially bright night-time cityscapes or moving cars captured using long exposures.

UFO vs. tank at a military training ground

Night Photography

Artificially lit buildings, skylines and moving cars are all popular passive night-time photo subjects. Besides using long exposures, there are a number of other factors you need to consider when shooting at night.

For night-time photographers, the moon is not only a primary source of light but also an important artistic device. In light cloud cover, it produces wonderful lighting textures in skies that can otherwise appear quite dull. Its soft light is equivalent in strength to that produced by a single candle reflected by a white surface six feet away and produces cool colors in the resulting photos.

The moon is an important factor in night-time landscape photography, contributing overall compositional light to the artificial light photographers use to accentuate details and textures in a scene. In the course of a long exposure, natural and artificial light blend to produce well lit subjects with soft accents and transitions.

During a full moon, you can stop a three-minute exposure at ISO 100 down as far as f6.3. If you use f8 and extend your exposure to 10 minutes or more, you will not easily be able to tell the result apart from a shot taken in daylight. Only the stars betray the time of night and the long exposure (see the image on page 94).

The time between sunset and the onset of darkness is often called the 'blue hour', due to the deep blue of the sky with its color temperature of between 9,000 and 12,000 K (Kelvin). The blue hour lasts between half an hour and 50 minutes, depending on the season and your location, and often provides sufficient light for shooting balanced, high-contrast images.

Close up, a single street lamp can produce so much light that it makes LAPP shots impossible, although it can act as a useful secondary light if it is far enough from the scene of the action. I like to use the distant light of the city of Bremen where I live to light landscape scenes located far from the city itself. In these cases clouds are a boon, acting like a giant reflector that bounces the city light many miles into the surrounding countryside. Moonlight and clouds are often the basic ingredients of unique and wonderful night-time scenes.

Choosing Your Gear

A heavy, high-end tripod and a remote shutter release are essential for night-time and light art photography due to the long exposures involved.

It is often difficult to position your camera accurately in the dark, so using a spirit level attached to your camera's flash shoe is a simple way to ensure that everything is set up correctly before you shoot. You can also use a two- or three-way spirit level to help you avoid capturing converging lines in architectural backgrounds.

A high-quality wide-angle lens is also essential. I like to use a Zeiss Distagon 21mm f/2.8 or a Canon 14mm f/2.8L II, both of which produce excellent sharpness. The Canon has an angle of view of 144 degrees (compared to the 180 degrees we can see with both eyes). Both lenses are also extremely well corrected and produce only minimal barrel distortion.

In addition to these contemporary lenses, I still use my 40-year-old Leica 35mm f/2.0 Summicron with a Novoflex adapter. This lens still produces unbeatable sharpness and detail in spite of its age. Unfortunately, most Leica lenses are too long to fit the Canon EOS system's short flange depth and interfere with the mirror during exposure.

Another lens that I use if I don't need soft bokeh effects is my fully manual Samyang 14mm f/2.8, This lens has only six non-rounded aperture blades but produces extremely sharp results. The downsides of this particular lens are its fairly obvious barrel and wave distortion and its lack of multi-coated
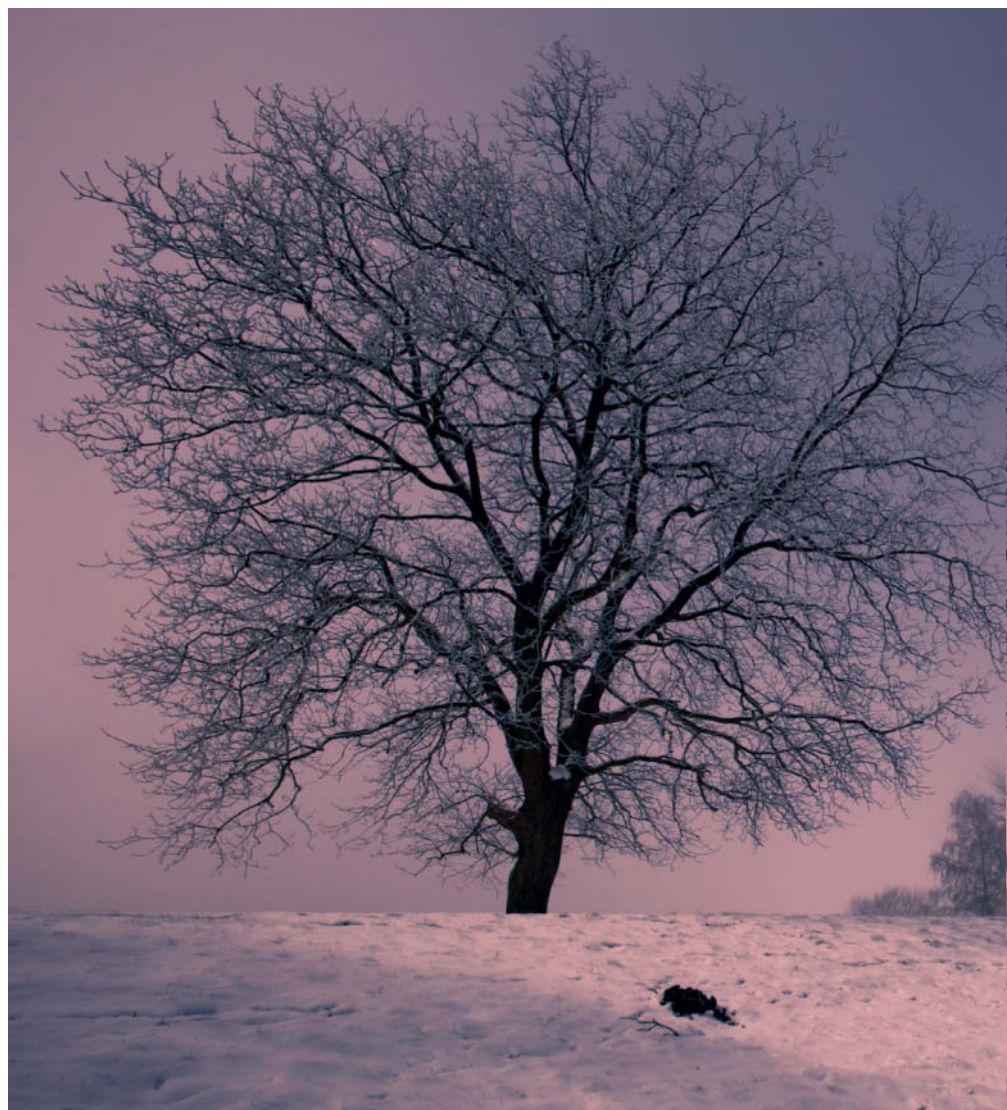
elements. The latter, something it has in common with many older lenses, makes it prone to capturing stray light, flare and ghosting effects. On the other hand, that is exactly what makes it so interesting to use. Used carefully, these characteristics can be applied deliberately to produce compelling light art effects.

I use Novoflex adapters to attach older lenses to my Canon EOS 5D MKII. Experience has shown that cheaper adapters are not as precisely machined and often don't lie flush with the camera's lens throat. If you are using a modern camera and a high-end lens, it simply doesn't make sense to risk spoiling the results by using a cheap adapter.

Reducing Noise

The more densely packed the individual pixels on an image sensor, the more likely they are to cause interference with their neighbors. Image noise also increases with sensor temperature and higher ISO values. There are various ways to avoid producing reduced-quality images or to improve image quality after shooting:

1. Reduce your ISO value setting to a usable minimum value – 100 is usually best
2. Use a camera with a large image sensor
3. Shoot in cold weather or use other means to cool the image sensor
4. Use image processing tools to reduce the incidence of noise artifacts
5. Use Topaz *DeNoise* to optimize high-noise, ultra-long exposure images. This software significantly reduces noise and sharpens the results at the same time.

Avoiding Camera Shake

You will need to use a tripod and mirror lock-up to prevent camera shake during long exposures. Mirror lock-up raises the camera's mirror before the actual exposure and lowers it after the exposure is finished to reduce the risk of mirror movements causing camera shake. If you use mirror lock-up, you will also have to use your camera's self-timer, otherwise the mirror will be raised but no exposure will be made.

It is often useful to operate the self-timer using a remote shutter release. More expensive remote releases have timing mechanisms that you can set to give yourself extra seconds to prepare for your performance in front of the camera.

Lighting Gear

Light sources have to be selected with a view to the brightness of the ambient light illuminating the surroundings. For example, I use my brighter lamps for dawn shoots or at locations where there is a lot of ambient industrial or urban light pollution. I often try to find locations in artificially shaded corners to give my light art pieces a dark background.

There are many different approaches to constructing and using lighting tools. Many of my best ideas occur when I am actually handling lamps, toys and other lighting props. You can often find me in dime stores or hardware and remainder stock stores testing anything and everything that produces light of some sort. Every light source has its own particular character and produces unique effects.

LED flashlights are ideal for use in light art photography situations. Modern high-performance LEDs produce clean, balanced light close up and at larger distances. They are much more versatile than traditional fixed-lens lamps, in which the shape and strength of the light beam are predetermined during manufacture.

I like to use the LED Lenser X21 model, firstly, because it has a built-in focusing system and secondly, because it has an unbeatable 1,000 lumens of power, which is almost as bright as a car headlamp. The X21 is capable of illuminating subjects over distances of more than 500 meters – a fantastic feature for use in Portable Lightbrush Photography (PLP) situations. It can precisely target light and produce accents using previously unheard of directionality – for example, to accentuate just the ears on the corn stalks in a field.

A pump house on the River Wuemme in light fog. The distant city of Bremen lit the fog from the left, while the main window of the building was illuminated through a side window.

PLP Techniques

Until recently, long exposures were usually seen as a necessary evil that had to be tolerated to achieve adequate lighting in a photograph, and were rarely used as a device for staging complex choreographies. In contrast, Portable Lightbrush Photography (PLP) techniques are a logical development of night photography and serve to actively integrate subsidiary light sources into the composition of long exposures.

In addition to applying selective accents and targeted light, PLP techniques are perfect for brightening the darker areas within a night scene. Dark corners occur not only at sunset and sunrise, but also in artificially lit and moonlit scenes. The exciting thing about PLP techniques is that they allow you to make selected objects disappear or previously hidden details visible.

PLP gives us a new view of familiar objects, using light sources that come from unfamiliar angles to produce unusual contrasts, or backlight to eliminate contrast altogether. This way, you can compose images that would normally be impossible to produce.

But PLP is not just a useful tool for outdoor photography. The crux of its use is the creativity you apply to developing new techniques while you work – in other words, using time in front of the open shutter like a stage on which you create choreographed sequences of steps using your lighting tools.

I recently developed a completely new portrait technique based on this idea.

I began to use light to paint within landscapes, rivers and architectural scenes about five years ago. The results back then were simple and it wasn't my intention to turn them into a new photographic technique.

I can clearly remember the 11-million-candela Johnson floodlight I acquired at a flea market. Powered by a 12-volt rechargeable battery, it was basically a halogen car headlamp built into a portable casing. It even had a dipped beam for close-ups and a main beam for use with distant subjects.

Apart from the heat it generated (great for shoots on cold winter days!), its 14-pound

Day or night? This photo of the River Wuemme was shot at 3 am under a full moon and shows ice floes moving downriver. The light trails of the stars hint at the long exposure time we used.

weight and 60-minute charge life made it tricky to use, and I learned to carry it on my shoulder like a ghetto blaster when I was using it to light a scene.

What I really liked about this monster was its warm, candle-like color temperature. unfortunately, that didn't change the fact that using it was like using a fat garden hose with no upstream pressure: lots of power, but no way to direct it.

Practical Accessories

The appearance of the iPhone and the iPad has made planning and executing projects of this type much simpler. Many really useful photo-based apps have appeared in the past year or two. Reliable weather forecasts are an essential component of every outdoor photographer's life, so *Weather Pro* has become one of my favorite apps.

Will it be windy tonight? Which direction is the wind coming from and how strong is it? What's the temperature? When is the rain due to start? I now carry all this information and more in my pocket and can see a seven-day forecast at the click of a button.

Along with the weather, the moon's cycle plays an important role in my work. *LightTrac* is an app I use to plan all my shoots and travel arrangements. For example, if I want to travel to the Thai island of Ko Tao for a night shoot I need to be aware that it is too far from the mainland to be influenced by urban light and has little illumination of its own. In other words, if the moon isn't visible during the shoot, it's going to be really dark. In order to integrate the phases of the moon into my travel plans, I have to know:

– where the moon rises, where it sets and how high its arc through the sky will be
– its apparent size on the date of my shoot
– whether it is waxing or waning

LightTrac can tell me all of this and, most importantly, displays the precise path of the moon across the sky at any given time. This allows me to plan work in distant locations months in advance, which is an enormous advantage.
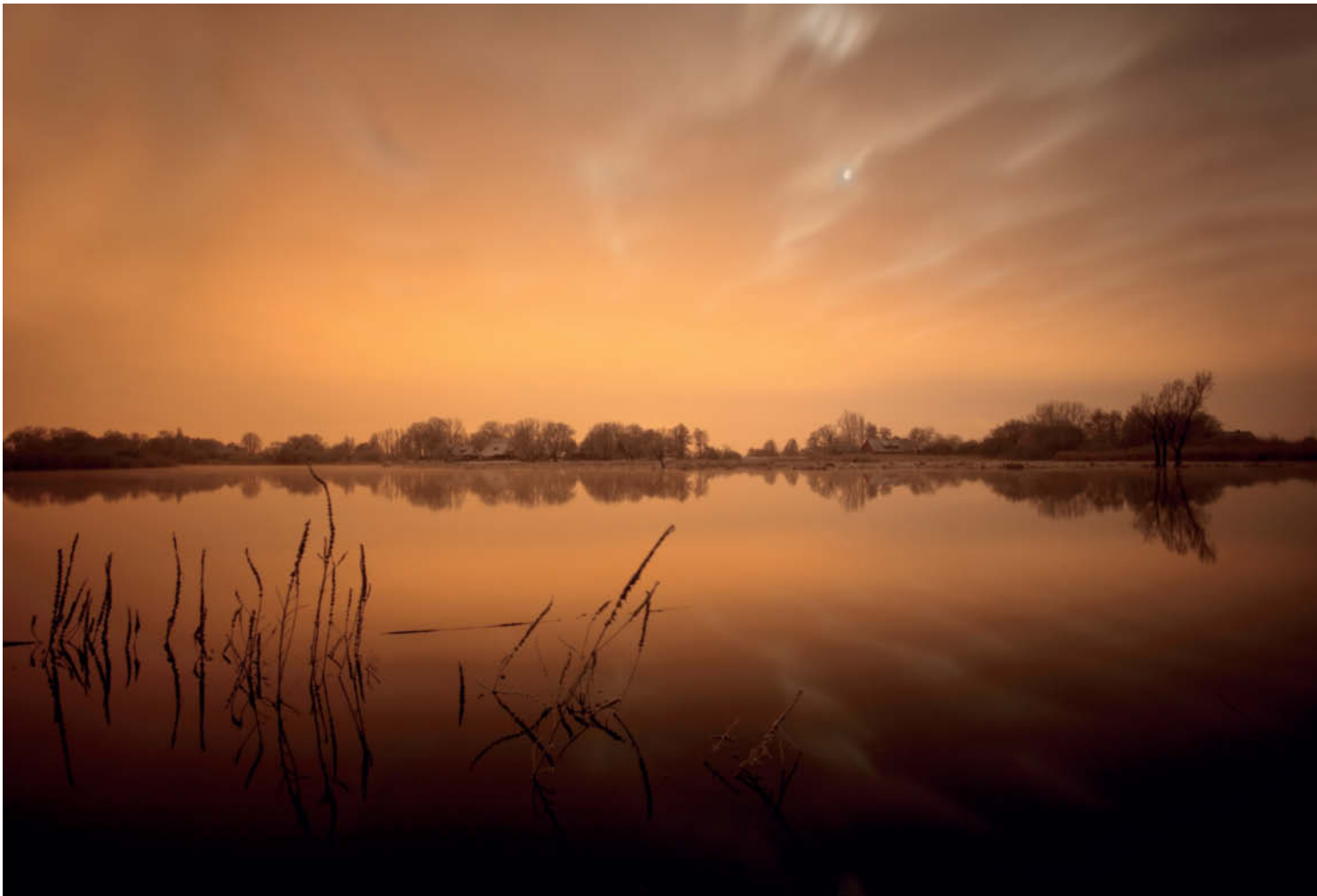
The River Wuemme illuminated by light from the distant city of Bremen. This photo was taken at 6 am on a rare wind-free night. An indescribably beautiful moment captured at -15°C in the type of ultra-clean air that makes endlessly sharp photos like this possible.

Photographed in the gym of a disused brewery in Berlin

LAPP Workshop

As its name suggests, Light Art Performance Photography – or LAPP for short – is a blend of light art performance and photography. 'Performance' is, of course, a term that can be very broadly interpreted. For this type of work, I use it to describe a pre-prepared show consisting of a planned sequence of steps.

The basic idea behind light art (or light painting) isn't new. Man Ray published a series of photos entitled *Space Writing* in 1935, and in 1949, inspired by *Life* photographer Gjon Mili, Pablo Picasso used a light bulb to make drawings in thin air.

Various approaches to composing long exposure photos have been lumped together under the umbrella term 'choreographic photography', but the planning, organization and rehearsing of LAPP works takes the process to a new level,

and allows the artist to execute carefully planned sequences of steps both as a photographer and a performer. In contrast to everyday photographers, light artists work with exposure times that range from 30 seconds to as long as 60 minutes or more.

Shot conventionally, this night shot produces a two-dimensional silhouette. The exposure time for image #3 was about 20 minutes at f6.3 and ISO 100. The background light from the city was given orange glow using a manual color temperature setting of 8,000 K. Without additional moonlight, it took a long time to make the texture of the corn ears visible.

This is the unretouched original photo as captured by the camera at the end of the pre-planned sequence of steps

It is these very long exposure times that give the artist the time to actively take part in the composition of the light captured in the photograph.

The length of the exposure depends on the complexity of the planned performance. In addition to creativity and imagination, light art performance requires good body control, stamina and a dose of choreographic talent to synchronize the movements of the lights with the performance.

Creating LAPP pieces requires clear communication between the photographer and the perfomer. I have got into the habit of clearly calling out each step, and I expect everyone else in the team to do the same. You can only produce a clean performance that consists of 30 or more individual steps (in the dark!) if everyone knows what everyone else is doing all of the time. We even use walkie-talkies if the performer is positioned a long way from the camera or if there is too much background noise, such as ocean sounds, wind or industrial noise, at the location.

Location Scouting

Before a LAPP shoot can begin, you have to find an appropriate location. I found the tree in a cornfield that we used for this workshop after visiting various locations on different days. I found some of them using Google Earth – the Panoramio images linked to many Google Earth locations are a great aid to gaining a first impression of a prospective locale.

Preparation

Before opening the shutter, the camera has to be carefully set up and leveled, and framing and focus set to perfection. It is much easier to do all this in daylight (see image #1 on page 98).

About the Author

JanLeonardo Woellert initiated the LAPP-PRO.de project with his friend, photographer Joerg Miedza, in 2007 and uses the platform to showcase the myriad possibilities offered by the world of LAPP and choreographed photography. Their experiments on both sides of the camera have led to the creation of endless new facets of the light art performance genre. The pair's www.lapp-pro.de website includes details of their unique work and documents their strong commitment to the wonderful world of light art performance.

Woellert and Miedza's book *Painting with Light* (ISBN 978-1-933952-74-1) was published in 2011 by Rocky Nook. This beautiful 208-page volume includes two comprehensive gallery chapters of spectacular LAPP images created by the inventors of the genre, as well as background stories and a 'making of' section describing the creation of selected projects.

JanLeonardo Woellert is a classically trained photographer who learned all about large-format landscape photography from Stephan Meyer-Bergfeld, among others. Inspired by a passion for light and darkness, he spent his early years using a Leica R camera to shoot slides exclusively at night.

Woellert's homepage at <www.lightart-photography.de> showcases images created using LAPP and other, newer techniques from the world of choreographed photography, as well as giving us some insights into his nighttime experiences and recent changes in the light art scene. His recent exhibition at the *Art Room9* gallery in Munich led to a new cooperation with the US artist Cubri.

Joerg Miedza · Jan Leonardo Woellert

Painting with Light

Light Art Performance Photography

rockynook

Illuminating the Background

On this particular day, the blue hour began at 22:30, so I immediately opened the shutter and began the exposure. At this time of day, there is enough residual daylight to make an exposure of between 60 and 120 seconds at f6.3 and ISO 100.

00:00–01:00 minutes: The first 60 seconds or so were spent illuminating the cornfield (image #2 on page 98). To do this, I used my LED Lenser lamp (item **6** on page 101) to 'paint' light onto the corn stalks using broad sweeps akin to using a spray can, and taking care not to use too much light in the foreground.

I like to use colored gels that alter the color temperature and the mood of the light my lamps produce. In this case, I used a warm-colored gel reminiscent of a rising sun. The accents on the corn ears create previously unseen contrast and gives the field extra emphasis against the sky and the background.

Illuminating the Tree

01:00–02:00 minutes: I lit the tree from a fair distance to cover the entire 180-degree angle of view and to prevent the formation of uneven shadows (see image #4 on page 98). This step also gives the tree trunk and the individual branches more emphasis. If you use fluorescent light for this type of shot in summer, the green of the leaves reflects the light in a very effective way, producing a particularly lush green as a result.

Beginners often stand still behind the camera and perform their lighting movements from there. In fact, it is much more effective to keep moving and to switch the lamps on and off quickly and precisely whenever and wherever they are needed.

Fast on/off switching prevents the lamp's constant beam from producing unwanted highlights when the air is full of moisture. The effect is the same as the one produced deliberately by the skybeams often used at funfairs and discotheques. In our scenario, a constant beam would produce unwanted highlights that obscure parts of the sky.

The same fast switching technique has proved very effective for illuminating trees too, especially in situations where there is mist in the air. A lamp that is rapidly switched on and off produces alternating
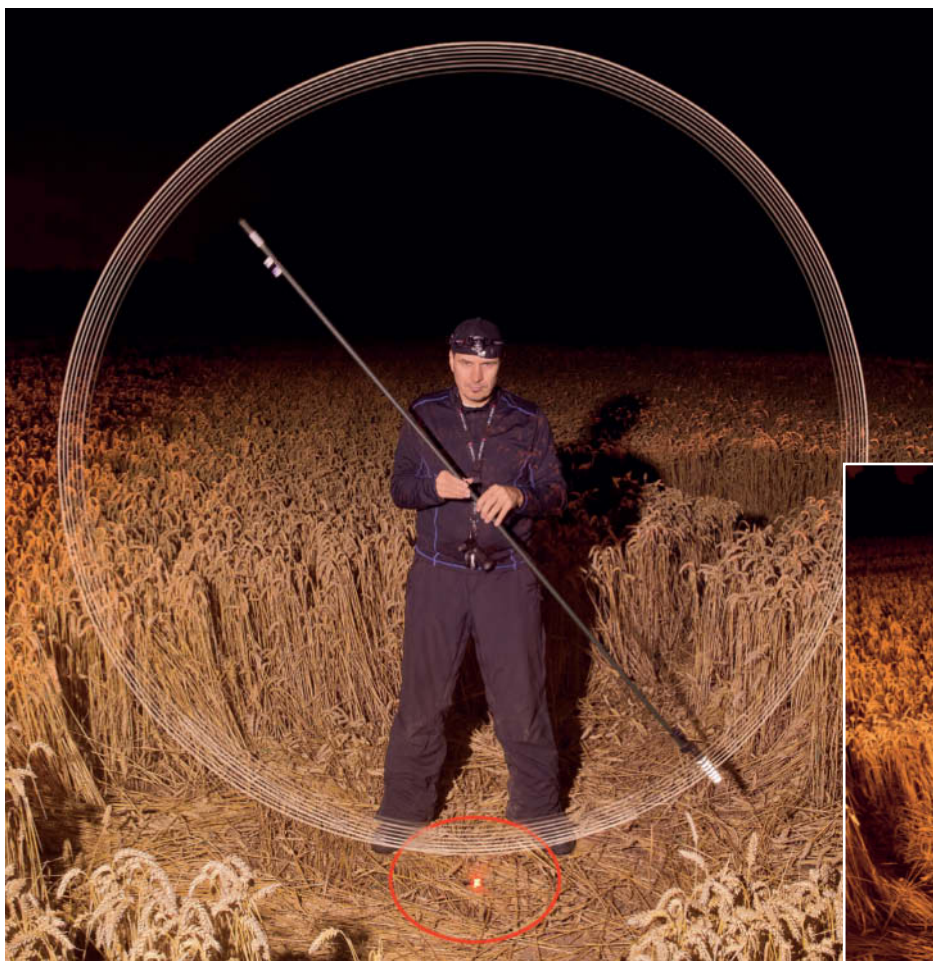
To ensure that the line of the outer 'skin' is cleanly drawn, you have to step to the side at exactly the moment when the light is not facing the camera (i.e., is at the 'rear' of the sphere). The white lines can then be drawn cleanly and perfectly in parallel.
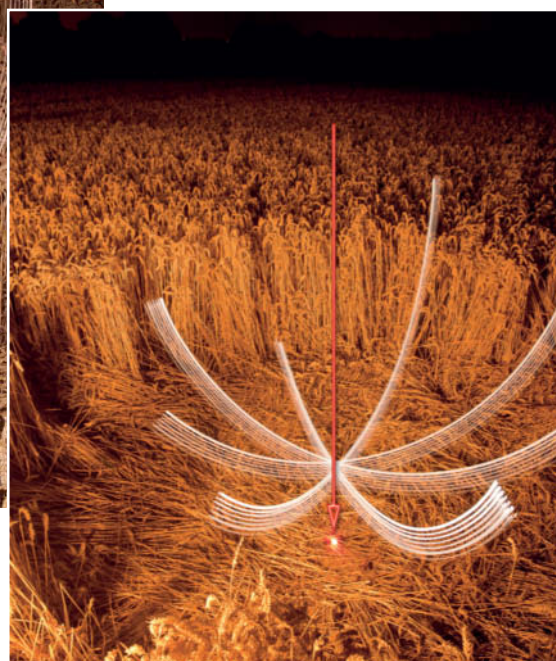
The glowing center point (in the middle of the red circle) serves to keep the center of the light sculpture in view in the dark. If the performer rotates directly around his/her own axis while drawing a light ball, the resulting sculpture will have a 'hole' at the top and the individual lines will not be parallel.

doses of light and darkness that effectively cancel each other out, and is even effective in falling snow.

The Performance

02:00 – 3:00 minutes: The next step is the actual performance that produces the light ball. It is much easier to produce this type of light sculpture if you work in a team. In principle, the ball is constructed by 'drawing' a series of precise circles using a 'performance stick' (see the box below for details).

The performer has to stand at the light ball's predetermined location and take a step to the right or left after each circle has been formed. It is essential for the performer to remain within a small, tight circle on the ground while drawing the ball: otherwise, the lines will not be parallel and the resulting ball will not be spherical.

The important thing here is to make sure that the lamp itself passes through a preset central point for every circle you make. To do this, the performer has to move around a circle with a circumference of about 30 cm (the red circle in the larger image on page 100) while creating the ball. The more precisely the performance stick is handled, the better the resulting ball will look.

To make it easier to find the center of the stick in the dark, I wind a piece of gaffer tape around the appropriate point. In the large image opposite, you can see that I am using my left hand to move the stick and my right hand to hold it in position.

With a little practice, you can perfect this technique to produce extremely accurately drawn spheres. The essence of this performance is accuracy, not speed.

Take care to keep the stick at 90 degrees to the ground when drawing a sphere. This ensures that all of the circles intersect at the same points at the zenith and nadir of the sphere.

Remember: the stick has to be well balanced in order to perform all of these steps smoothly and effectively. If I attach a lamp to one end of the stick, I have to use a counterweight at the other.

The final result of all this effort is the main image on page 98.   (keh) **c't**

The 'Performance Stick'

Building a performance stick is easy. An LED Lenser P5 lamp with a diffuser (**4**) is attached to one end and the two fluorescent concert sticks (**1 a**nd **2**) are attached about 20 cm from the other to produce a second level of light within the sphere.

The LED Lenser M1 (**8**) is switched to strobe mode, inserted into the plastic tube (**5**) and taped into place. The battery (**3**) is used to balance out any inconsistencies in the distribution of weight in the stick.

Adhesive Tape is King

By far the simplest and most effective way to make adjustments to the components of a performance stick in the dark is to use adhesive tape.

We have found that cheap, dime-store tape is actually very good for this type of application, as it stretches easily but doesn't tear. Nevertheless, you will probably need to use duct tape to affix heavier lamps and counterweights. Make sure that the tape you choose can be easily torn crossways and lengthways, so that you can quickly and easily prepare short and long pieces on location.

1. **Concert stick, blue**

2. **Concert stick, red**

3. **Battery (as counterweight)**

4. **LED Lenser P5 with plastic diffuser, attached to the performance stick (a six-foot plastic garden cane from a building supplies store)**

5. **Four-foot orange plastic tube covered in tape to reduce brightness**

6. **LED Lenser X21 (for main location illumination)**

7. **LED Lenser M7 (for subsidiary location illumination)**

8. **LED Lenser M1 (in strobe mode to light up the orange tube)**

9. **Adhesive tape**

For more information on LED Lenser products, visit www.ledlenser.com

Dr. Klaus Peeck

System Camera Test

This issue's multi-camera test covers four system cameras and a high-end compact as a comparison. We took an in-depth look at the new class of camera introduced with the Nikon 1's CX-format sensor, and marvelled at the autofocus speed of the Olympus PEN E-P3. Meanwhile, Sony is still cranking out resolution with its 16-megapixel mirrorless NEX-5N and the full-on 24-megapixel wonder of the SLT-A77V DSLR model. Our comparison compact, the Nikon Coolpix P7100, has a 1/1.7" sensor and a class-leading feature set.

Camera Overview

Mirrorless cameras can be constructed to much smaller dimensions than single-lens reflex (SLR) cameras because the bulky mirror box doesn't have to be included in the design and the rear element of the lens can be positioned much closer to the image sensor. This means that lenses for mirrorless cameras can be constructed with smaller diameters, making them much more compact than their DSLR counterparts. Additionally, the smaller the sensor, the smaller the overall lens design can be too, so lenses designed for the Micro Four Thirds system are generally smaller than those built for APS-C cameras. The new Nikon 1 series lenses are even smaller than that.

Another factor that influences the size of mirrorless camera bodies is the inclusion (or exclusion) of a built-in electronic viewfinder. Most cameras without built-in viewfinders have slot-in viewfinders available as an accessory. These make the camera larger, but at least allow you to choose which way you want to view and frame your images. Unlike conventional SLR viewfinders, electronic viewfinders allow you to brighten the viewfinder image artificially in bright ambient light, display image and camera data and also review images after shooting without having to take the camera away from your eye. With the SLT-A77V, Sony has introduced a 2.4-megapixel electronic viewfinder that exceeds the resolution of the optical viewfinders built into many entry-level and mid-market DSLRs.

Mirrorless technology also reduces the number of motorized moving parts, which not only enables higher burst shooting rates, but also extends the potential lifespan of the camera as a whole. The downside of Sony's SLT semi-transparent mirror technology is that it swallows 30 percent of the light entering the camera before it reaches the sensor and diverts it to the permanently active autofocus sensors instead.

The disadvantages of mirrorless cameras are disappearing fast as technological development progresses and, although it is unrealistic to expect a system camera with a zoom lens to reach anything like the tiny dimensions of today's ultra-compact pocket cameras, many high-end compacts, such as the Nikon P7100 tested here, are fitted with lenses that are better than many of the kit lenses delivered with system cameras. Of course, interchangeable lenses represent a clear advantage over fixed lenses in many situations, but choosing one over the other is often simply a matter of features versus available budget.

The dedicated AF sensors that have given DSLRs the edge over mirrorless cameras are rapidly losing their cachet. Leading the charge is the Olympus PEN E-P3, which focuses with DSLR-like speed at all focal lengths and only begins to weaken very slightly in very low light. The P7100 has excellent AF characteristics, but our tests showed that it simply cannot compete with the Olympus for overall focus performance. Sensor-based contrast detection autofocus provides great potential for precision and, due to the way it is constructed, avoids the front and back focus issues often associated with DSLRs. Many reputable test labs have found that mirrorless cameras frequently beat DSLRs for autofocus consistency.

Electronic viewfinders often can't keep pace with burst shooting, which can be confusing for the photographer during pans that track fast-moving subjects. The same is, however, also true for cameras without viewfinders when bright ambient light makes it impossible to follow the action using the camera monitor. In this respect, mirrorless system cameras are no better than conventional compacts. The P7100's optical viewfinder is at best a compromise and offers only a tiny 'tunnel' view while suffering from severe vertical parallax.

Sensors

Nikon's 1 series has introduced a new class of sensor to the mirrorless market. The CX format sensor measures 13.2×8.8 mm, giving it a surface area of about 116 mm², which is equivalent to about twice that of the P7100's 1/1.7" model and about half that of a Micro Four Thirds sensor. The APS-C sensors built into both Sony test cameras measure 23.5 × 15.6 mm, resulting in a surface area of 366 mm², which is more than three times as large as the Nikon 1's. However, it is not the absolute size of a sensor, but rather the size of each individual pixel that is the most important factor in determining the light sensitivity and therefore the quality of the images it produces. Pixel size and the number of pixels determine the pixel density of a sensor.

The current series of Nikon CX sensors are 10-megapixel models, which equates to pixels (i.e., single photodiodes) that measure 3.4 µm on each side. The Micro Four Thirds sensor built into the Olympus PEN E-P3 has 12 megapixels of resolution, which equates to a pixel edge length of 4.3 µm. The two Sony sensors vary greatly due to their different resolutions. The NEX-5N's relatively moderate 16 megapixels give it a pixel side length (or 'pixel pitch') of 4.8 µm, compared with the very dense 24-megapixel sensor built into SLT-A77V, which gives it a pixel pitch of just 3.9 µm – less than that of the Micro Four Thirds-based Olympus.

The NEX-5N's relatively large pixels give it the best signal-to-noise ratio in our test – values which hold true all the way up to ISO 3200. The camera's visual noise performance is also the best of the bunch, especially at high ISO settings, and these results are backed up by its maximum contrast results up to ISO 3200 too. On the other hand, the SLT-A77V'S sensor, with its densely packed pixels, shows typical signal-to-noise fall-off and reduced maximum contrast at ISO values above 800. Visual noise remains acceptable up to ISO 3200, although this has more to do with the camera's strong built-in noise reduction features than with the sensor's own photographic strengths. A quick look at our test images shows obvious detail-killing noise reduction at high ISO values. At medium ISO settings, noise reduction remains moderate, although even this at at the cost of obvious color noise artifacts in gray image areas at values above ISO 400. All our other test candidates produced better results, and the SLT-A77V only just managed a 'satisfactory' overall noise rating.

The Nikon V1, too, with its tiny CX sensor, displays poor signal-to-noise characteristics above ISO 100 and poor visual noise behavior at all levels. Our test shots show obvious luminance noise at ISO 100, although its effects are minimal up to ISO 400. However, results suddenly lose detail and begin to look dull and show sloppy transitions above ISO 800. Maximum contrast is satisfactory at best. The PEN E-P3 also shows obvious noise reduction artifacts quite a way down the scale, but shows good signal-to-noise and visual noise behavior right up to ISO 800, beyond which both fall off rapidly. The camera's maximum contrast test results confirm these tendencies, producing only satisfactory results in our subjective visual test. The P7100's small 1/1.7" sensor is, naturally, the worst of the bunch in this test, but unfortunately doesn't even compare favorably with a range of compacts with even smaller 1/2.3" sensors. It only produces really clean results at ISO 100, although results are still passable at ISO 200.

Above ISO 400, there is obvious luminance noise, which increasingly reduces overall sharpness. Additional details on all aspects of each camera are listed in the individual overviews below.

Features and Handling

The SLT-A77V is large and its partially customizable controls are all easy to reach. The multi-selector and dials are simple to use for entering user-defined values or navigating the clear main menu and the icon-driven quick function menus. The monitor is extremely flexible and can be tilted, swiveled and shifted upward to a position above the top of the camera body. In addition to SLT continuous AF technology that is purported to work even at burst speeds of 12 fps, other features include GPS, Auto HDR, Anti Motion Blur and the slightly fractious 3D Sweep Panorama feature.

All three mirrorless cameras offer reasonable handling, but the Nikon P7100 proves that a small camera doesn't necessarily have to have small, fiddly controls. The Nikon's clear main menu and quick access sub-menus are the best in our test and are ably supported by two command dials and a multi selector.

In spite of its high-resolution monitor, the Nikon 1 V1 offers a thoroughly conventional three-tab main menu and no quick menu feature at all. It is also inexplicable why Nikon should have decided to give the 1 V1's multi selector only four main functions and no control over basic shooting modes. Although its controls are precise and it is generally well balanced, the V1's handling is unnecessarily menu-driven.

On the plus side, the V1's 1.4 million-dot electronic viewfinder produces a very sharp image. The camera also offers some interesting and unusual high-speed features, such as Smart Photo Selector Mode, which rapidly shoots a sequence of 20 shots every time you press the shutter button and automatically selects what it perceives to be the best shot of the sequence as well as four additional best shot 'candidates'. Motion Snapshot mode records a still image and about a second of movie footage, which it then plays back in slow motion followed immediately by the photo itself.

System Cameras: Test Results, Part 1

	Sensor-resolution [lp/h] better ▶	Relative center resolution (ISO 100, wide-angle) better ▶	Center Resolution (ISO 100) [lp/h] better ▶	Center resolution (ISO 400, wide-angle) [lp/h] better ▶	Center resolution (ISO 1600, wide-angle) [lp/h] better ▶	Center resolution (ISO 3200) [lp/h] better ▶	Center resolution (ISO 6400) [lp/h] better ▶	Center resolution (ISO 12800) [lp/h] better ▶	Contrast range/subject range, ISO 100 [in f-stops] better ▶
Nikon 1 V1 with 1 VR 10-30mm F/3.5-5.6	1296	94	1219	1155	1116	1046	962	–	8.3
Olympus PEN E-P3 with M.Zuiko 17mm f/2.8	1512	100[1]	1512[1]	1455	1309	1307	1057	962	8.7[1]
Sony NEX-5N with SEL 1855 18-55mm f/3.5-5.6	1632	84	1377	1390	1388	1370	1172	1140	9.7
Sony SLT-A77V with Minolta AF 50mm f/1.4	2000	80	1593	1659	1608	1303	1207	1090	9.7

Resolution was determined visually in units of vertical line pairs [lp/h]. The larger the value, the sharper the image.   [1] Measured at ISO 200 minimum sensitivity setting.
The logarithmic density, D, represents the camera's dynamic range in terms of the ratio between the brightness of the subject and the corresponding recorded tonal values. Higher values are better. Real subject range represents the range of tonal

System Cameras: Test Results, Part 2

	Signal-to-noise ratio [S/Nx] ISO 100 better ▶	Signal-to-noise ratio [S/Nx] ISO 400 better ▶	Signal-to-noise ratio [S/Nx] ISO 1600 better ▶	Signal-to-noise ratio [S/Nx] ISO 3200 better ▶▶	Signal-to-noise ratio [S/Nx] ISO 6400 better ▶	Signal-to-noise ratio [S/Nx] ISO 12800 better ▶	Visual noise OECF20 ISO 100 ◀ better	Visual noise OECF20 ISO 400 ◀ better
Nikon 1 V1 with 1 VR 10-30mm F/3.5-5.6	36	26	26	21	21	–	1.3	1.6
Olympus PEN E-P3 with M.Zuiko 17mm f/2.8[1]	51[1]	52	33	29	20	15	1.0[1]	1.1
Sony NEX-5N with SEL 1855 18-55mm f/3.5-5.6	72	56	50	48	31	27	0.6	0.7
Sony SLT-A77V with Minolta AF 50mm f/1.4	59	50	37	30	26	21	0.7	0.8

Higher signal-to-noise ratio values indicate better image reproduction with less unwanted noise.
'Visual noise' is a physiologically-based judgement of how 'irritating' certain image noise artifacts appear to the viewer. The values are calculated based on the intensity, frequency, and color of the perceived noise artifact.
Values below 0.8 represent virtually noise-free images, values below 2 low-noise reproduction, while values between 2 and 3 represent visible but acceptable noise levels. Values above 3 represent disruptive noise levels.
Values of 5 and above represent extreme, unacceptable noise.

Comparison Test

Nikon Compact: Test Results, Part 1

	Center resolution (ISO 100, wide-angle) [lp/h] better ▶	Diagonal resolution (ISO 100, wide-angle) [lp/h] better ▶	Center resolution (ISO 400, wide-angle) [lp/h] better ▶	Diagonal resolution (ISO 400, wide-angle) [lp/h] better ▶	Center resolution (ISO 800, wide-angle) [lp/h] better ▶	Diagonal resolution (IS83200, wide-angle) [lp/h] better ▶	Center resolution (ISO 1600, wide-angle) [lp/h] better ▶	Diagonal resolution (ISO 1600, wide-angle) [lp/h] better ▶	Center resolution (ISO 3200, wide-angle) [lp/h] better ▶	Diagonal resolution (ISO 3200, wide-angle) [lp/h] better ▶	Center resolution (ISO 100, tele) [lp/h] better ▶
Nikon Coolpix P7100	1347	1246	1235	1108	1136	1009	1038	917	–	–	1175

Resolution was determined visually in units of vertical line pairs [lp/h]. The larger the value, the sharper the image.

Nikon Compact: Test Results, Part 2

	Signal-to-noise ratio [S/Nx] ISO 100 better ▶	Signal-to-noise ratio [S/Nx] ISO 400 better ▶	Signal-to-noise ratio [S/Nx] ISO 800 better ▶	Signal-to-noise ratio [S/Nx] ISO 1600 better ▶	Signal-to-noise ratio [S/Nx] ISO 3200 better ▶	Visual noise OECF20 ISO 100 ◀ better	Visual noise OECF20 ISO 400 ◀ better	Visual noise OECF20 ISO 800 ◀ better	Visual noise OECF20 ISO 1600 ◀ better
Nikon Coolpix P7100	38	27	21	17	–	1.0	1.7	2.0	2.9

'Visual noise' is a physiologically-based judgement of how 'irritating' certain image noise artifacts appear to the viewer. The values are calculated based on the intensity, frequency, and color of the perceived noise artifacts.
represents extreme, unacceptable noise .

The Olympus PEN E-P3 is comfortable to use if you leave the handgrip attached. The camera is not appreciably larger than the Nikon, in spite of its much larger sensor. The camera's buttons are a little on the small side, but the dials are well-organized and precise and allow a high degree of customization. This model shares its over-complex menu structure with its PEN sister models, although it is possible to reduce this complexity using custom menus. The touch-enabled monitor screen can be used to select AF points or to release the shutter, and also includes a range of touch-driven Quick Guides that help to make up for the cumbersome menu system. Other touch functions include playback zoom and photo scrolling which, although not particularly sophisticated, are still a bonus.

The Sony NEX-5N also has a touch screen that can be used to access a multitude of functions. We found the labeling of the six basic touch buttons slightly confusing – for example, the Brightness/Color menu also includes shooting mode, white balance and ISO value settings. The second menu level includes some very long lists of settings that are quite difficult to navigate using gestures. Fortunately, the control wheel can be used to navigate here too, preventing the camera from becoming an ergonomic disaster. There are no quick menus for accessing major functions, making it necessary to maneuver via the main menu for all functions that aren't covered by soft key short cuts. Otherwise, the camera back has just two other buttons which are used to select functions covered by the icons located at the

edge of the monitor screen. Annoyingly, these include the basic P/A/S/M settings which are normally controlled by a camera's main mode dial – a feature that is missing from the Sony. The grip is a positive feature of the camera's otherwise very slim body, and its lens rings and control dials are precise and easy to use.

The NEX-5N shares some of the SLT-A77's automated shooting features, including 3D Sweep Panorama, Auto HDR and Anti Motion Blur. There is also a built-in help guide.

Shooting Video

All the system cameras we tested are capable of shooting Full HD video at 30 fps, and both Sonys can even shoot at 50 fps, providing very smooth footage that doesn't judder (or 'jelly') during pans the way videos shot using the Olympus do. The Sony NEX-5N delivered the best overall video quality, with sharp, highly detailed footage and precise, noise-free autofocus. The SLT-A77V only manged a 'good' overall video result in our test, and footage became visibly grainy in low light with some slight interference shimmer. Focus tracking is fast, but produces some traces of motor noise on the audio track.

The Nikon V1 also produces 'good' video clips with some of the best colors in this test. Sharpness was also good to middling, especially at wide-angle settings, and autofocus was quick and noiseless. The zoom ring is very quiet, too, if moved quickly. The PEN E-P3 produced only 'satisfactory' video clips with low visual resolution, artificial-looking sharpness, visible grain and artificially warm colors. AF tracking was inclined to jump a little and was sometimes quite slow. The Nikon P7100's 720p, 24-fps video performance was typical for a compact camera with a 1/1.7" sensor. Color and image stabilization were good, but this quality of footage simply doesn't contain enough detail or sharpness.

Contrast range/subject range, ISO 400 [in f-stops] better ▶	Contrast range/subject range, ISO 1600 [in f-stops] better ▶	Contrast range/subject range, ISO 3200 [in f-stops] better ▶	Contrast range/subject range, ISO 6400 [in f-stops] better ▶	Contrast range/subject range, ISO 12800 [in f-stops] better ▶	Real subjecr range [# of tonal values] better ▶	Color Checker SG (Δ E) ◀ better
8.3	9.0	8.0	8.0	–	255	10.3
8.7	8.0	7.3	6.7	6.0	252	9.8
10.7	9.3	9.0	8.0	7.3	254	9.4
9.7	8.7	7.7	7.3	6.7	254	10.7

values contained in an 8-bit rendition of a test image.

Visual noise OECF20 ISO 1600 ◀ better	Visual noise OECF20 ISO 3200 ◀ better	Visual noise OECF20 ISO 6400 ◀ better	Visual noise OECF20 ISO 12800 ◀ better	Startup time [s] ◀ better	Shutter lag [s][2] ◀ better
1.8	2.4	2.8	–	1.0	0.29
1.8	2.1	3.1	4.4	0.8	0.20
1.1	1.4	1.5	1.8	0.9	0.64
1.5	1.6	2.0	2.8	1.0	0.29

[1] Measured at ISO 200 minimum sensitivity setting.
[2] Measured using the kit lens.
[3] Except Olympus PEN E-P3: measured using Olympus M.Zuiko 9-18mm f/4-5.6, and Sony SLT-A77V: measured using a Zeiss Vario-Sonnar 24-70mm f/2.8.

Diagonal resolution (ISO 100, tele) [lp/h], better ▶	CCD resolution (not measured) [lp/Bh] better ▶	Relative center resolution (ISO 100, w-a) / sensor resolution [%] better ▶	Relative diagonal resolution (ISO 100, w-a) / sensor resolution [%] better ▶	Resolution dropoff center / diagonal (ISO 100, w-a) [%] ◀ better	Contrast range/subject range ISO 100 [in f-stops] better ▶	Contrast range/subject range ISO 400 [in f-stops] better ▶	Contrast range/subject range ISO 800 [in f-stops] better ▶	Contrast range/subject range ISO 1600 [in f-stops] better ▶	Contrast range/subject range ISO 3200 [in f-stops] better ▶	White balance in daylight [Digital values] ◀ better	Color Checker SG Δ E ◀ better
1183	1368	98	91	7	10,0	8,7	8,7	7,0	–	0	10,2

Visual noise OECF20 ISO 3200 ◀ better	Distortion wide-angle [%] ◀ better	Distortion telephoto [%] ◀ better	Vignetting wide-angle [in f-stops] ◀ better	Vignetting telephoto [in f-stops] ◀ better	Chromatic aberration wide-angle ◀ better	Chromatic aberration telephoto ◀ better	Startup time [s] ◀ better	Shutter lag wide-angle [s] ◀ better	Shutter lag telephoto [s] ◀ better
–	1,3	0,5	0,6	0,4	0,4	0,5	1,4	0,27	0,57

Values below 0.8 represent virtually noise-free images, values below 2 low-noise reproduction, values between 2 and 3 represent acceptable noise levels. Values above 3 represent disruptive noise levels, while 5 and above

Exposure tracking was slow and visibly stepped, and the autofocus system constantly 'pumped' back and forth in its search for the right setting. If the motorized zoom is activated, focus tracking switches off altogether.

The Nikon 1 V1 produced the best sound, followed by the Sony DSLR, with its slightly weak bass reproduction. The same is true of the NEX-5N, which produces fairly flat sound and has a zoom ring that produces audible soundtrack noise – all in all, only 'satisfactory' performance. The left-hand channel in our test model was much quieter than the right-hand one and, like the Olympus, tended to favor high frequencies. The P7100's sound was muffled and at best 'satisfactory'.

Conclusions

"Pixel size matters" is still the golden rule when you are looking for a digital camera that captures images with high dynamic range and low noise. Interchangeable-lens cameras are basically a good choice, and even the Nikon1 V1, with its relatively small sensor, still has almost twice as much sensor surface area as high-end, 10-megapixel compacts like the Nikon P7100 tested here or the Canon PowerShot G12. Appropriately, the V1's noise characteristics placed it between the best currently available compacts and the Olympus PEN E-P3, with its 12-megapixel Micro Four Thirds sensor. Sony's two APS-C cameras display radically different noise characteristics, and the NEX-5N, with its relatively low 16-megapixel resolution and large photodiodes is the best of this particular bunch. The 24-megapixel SLT-A77V almost came bottom of the class, and placed between the Olympus and the Nikon 1 V1.

The V1 represents an interesting new class of camera with astonishing capabilities, the most surprising of which is the Best Shot feature that actually appears to make value judgments about the composition of the images it captures. There is an adapter available for attaching 35mm system lenses to the V1 which, with its high-speed shooting capability and 2.7× crop factor, could be of particular interest to nature and animal photographers. However, in spite of its smaller sensor, the Nikon is physically not very much smaller than the Olympus. The E-P3's extremely fast sensor-based AF system is a sure sign of things to come and signifies a further nail in the coffin of conventional DSLR technology, which has so far been able to justify its existence with the speed of its dedicated AF sensors.

Sony has simply abolished mirror noise and vibration by using a fixed, semi-transparent mirror that diverts 30 percent of the incident light directly to the AF sensors but enables reliable continuous focus tracking, even at high burst shooting speeds. The SLT-A77V's 2.4 million-dot electronic viewfinder also has the potential to supersede conventional SLR viewfinder technology and delivers a bright, highly detailed image that is better than that produced by many entry-level and mid-market optical viewfinders.

Today's DSLR technology is expensive to produce and mechanically vulnerable, making it destined for extinction sooner or later. Should we mourn its passing? I think not.   (pen)

Comparison Test

Nikon Compact

Manufacturer and Model	Nikon Coolpix P7100
URL	www.nikon.com
Digitization	
Native resolutions (in pixels)	3648 × 2736, 3648 × 2432 (3:2), 3264 × 2448, 2736 × 2736 (1:1), 3584 × 2016 (16:9), 2592 × 1944, 2048 × 1536, 1600 × 1200, 1280 × 960, 1024 × 768, 640 × 480
Sensor type, effective megapixels / Size	CCD, 10 / 1/1.7"
Image format(s) / Compression rates / Video format	RAW + JPEG / 3 / MPEG-4 H.264
Video: max. resolution [pixels], length, fps	HD 720p, 29 min., 24
Memory card type / average file size[3]	SD(HC/XC) up to UHS-1, Eye-Fi (+ 94 MB internal) / 4.1 MB
Features	
ISO settings	4× auto (100–200/400/800/1600), 100, 200, 400, 800, 1600, 3200, 6400, (12800)
Max aperture / steps / Mechanical image stabilization	f/2.8–5.6 / 10 (WW)–4 (T) / ✓ (in-lens)
Exposure times [s]	(M: 60, A/S: 4) 2-1/4000 [5]
Zoom / Steps / Equivalent focal length range	7× / 20 or 1-7 (selectable) / 28-200
Minimum wide-angle subject distance macro / standard [6]	1.5 cm / 12 cm
Focusing / AF focus areas / AF-assist lamp	AF (one-shot, continuous, tracking), MF / 9, 1 (3 sizes or 99 positions), face detection / ✓ (orange)
Metering: Matrix / Center-wighted / Spot	✓ / ✓ / ✓
Programmed auto / Scene modes / Custom Presets	✓ (with shift and scene recognition) / 18 / 3
Exposure: Aperture priority / Shutter priority / Manual	✓ / ✓ / ✓
Exposure compensation [EV]	±3 EV in 1/3 steps (separate dial)
Bracketing: Exposure / WB / Focus /	✓ / ✓ / – (+ ISO bracketing)
Self-timer / Continuous shooting speed[3]	10 or 2 s / Approx. 1.2 fps, approx. 50 shots
Interval mode / Sound / Memo function	✓ (30 s-10 min) / ✓ (16-bit, stereo, 48 kHz) / 20 s
White balance: Auto / Presets / Manual	2 / 7 / 3 (with fine-tuning and Kelvin values)
Sharpness / Contrast / Saturation / Noise reduction adjustable	✓ / ✓ / ✓ / ✓
Monitor: Size / Resolution (dots) / Protective cover / Viewfinder	3-inch (vertically tiltable) / 921,000 / ✓ / ✓ (optical, with adjustable diopter setting)
4-way selector / Multi selector / Command dials	✓ (+ center button) / 3 / 3 (front, rear and rotary 4-way selector)
Flash compensation / Recycle time[7] / Connector	±2 EV in 1/3 steps / 4.3 s / ✓ (TTL shoe)
Playback	
Multiple [# of images] / Zoom / Histogram	72, 16, 9 or 4 / ✓ (up to 10x) / ✓ (while shooting too)
Connectors / Dimensions	
Power source	AC adapter (proprietary), rechargeable Li-Ion battery
Interfaces / A/V out / HDMI / Printer	USB 2.0 / ✓ (+ Mic in) / ✓ (Type C) / ✓ (PictBridge)
Dimensions (W/H/D) / Approx. weight ready to shoot [6]	117 mm × 99 mm × 48 mm / approx. 395 g
What's in the Box	
Manual / User guide	Quick start guide, user manual (PDF only)
Accessories	Li-Ion battery EN-EL14 (7.4 V, 1030 mAh), charger, shoulder strap, USB and AV cables
Optional accessories	Lens adapter, wide-angle adapter, AC adapter, infrared remote release, accessory microphone, dedicated flash, camera bags
Software	
Standalone software (platform)	Nikon ViewNX 2 (Win/Mac)
Ratings	
Test images[1] (c't test image shot in daylight)	
Color rendition / Exposure	○ / ⊕
Sharpness / Detail rendition	⊕ / ⊕⊕
Image noise / Other artifacts[2]	○ / ⊕
HD video[1] / Sound	○ / ○
Ease of use / Printed manual	⊕ / ⊕⊕
Feature set[4] / Included accessories [4]	⊕⊕ / ○
RRP: Camera / Replacement battery (US$)	409 / 79

[1] Judged by eye on a calibrated monitor
  (applies only to these cameras and therefore not comparable with earlier tests)
[2] Sharpening and compression artifacts, noise, moirés, color fringing
[3] Using largest native image size and best JPEG quality
[4] Relative to similar class of camera
[5] Shortest exposure time not achievable at maximum aperture/telephoto setting
[6] Measured values
[7] Measured at maximum flash output

⊕⊕ excellent   ⊕ good   ○ satisfactory   ⊖ poor   ⊖⊖ inadequate
✓ included   – not included   n/a not applicable

Nikon Coolpix P7100

Large, very robust, full-functioned 10-megapixel camera with a 1/1.7" sensor and built-in optical viewfinder.

Good: Follow-up model for the P7000 with quick reaction times, vertically tiltable monitor and front sub-command dial. Metal body with useful rubberized grip and rear thumb pad. Many controls, including large mode dial, exposure compensation dial and quick menu button. Flat, precise, configurable rotary multi selector. Two customizable Fn (function) buttons. Motorized 7× zoom (28-200mm equivalent) with selectable zoom steps. Built-in ND filter. Sharp, high-resolution 3-inch monitor. Clear main menu. Fast AF, manual focus override, 1.5 cm macro focusing. Flexible programmed auto, three user setting modes, four Auto ISO settings and three white balance presets. High-power battery. Microphone socket. Voice memo function for still images.

Not so good: Low burst speed and sometimes very slow data saves. Lens not as bright as others in its class. Tiny viewfinder with vertical parallax. Poor AF in low light, produced unforced focus errors during our test. Medium-power flash unit, tends to overdo flash at close subject distances. Combined memory card/battery chamber too close to tripod thread.

Test results: Maximum contrast good at ISO 1000, satisfactory up to ISO 800, strong fall-off thereafter. Good visual noise behavior at ISO 100, dropping off toward ISO 800. Signal-to-noise characteristics only acceptable at ISO 100. Very obvious lens distortion at wide-angle settings. Low fringing values. At ISO 100, very good (98%) maximum resolution and just 7% edge softness. Shutter lag minimal at wide-angle, more obvious at telephoto settings.

Image quality: Red-tinged results and variable white balance in daylight for the c't test shot. Very consistent sharpness and good image detail for a 10-megapixel camera. Balanced but variable exposure. Obvious color shimmer on our line chart, but otherwise few moirés and well-compensated fringing. Very good results at ISO 100, clean colors and edges, very good texture detail, slightly reduced and duller at ISO 200, colors from mid-gray onward slightly patchy. Results not so clear and sharp at ISO 400 with obvious luminance noise. Detail and sharpness falls off further at ISO 800, with fine textures disappearing almost completely. Serious loss of detail and patchy noise artifacts at ISO 1600. Third best noise characteristics in our test.

Outdoor color rendition good and exposure balanced. Good sharpness (even in corners) throughout the focal length scale. Good image detail for a 10-megapixel camera. Generally very clean images at ISO 100. Not quite as good overall at ISO 200, but still perfectly acceptable. Some image quality drop-off at ISO 400, getting more obvious at ISO 800. Stark loss of sharpness and detail at ISO 1600. Results unusable above ISO 1600. Minimal fringing throughout.
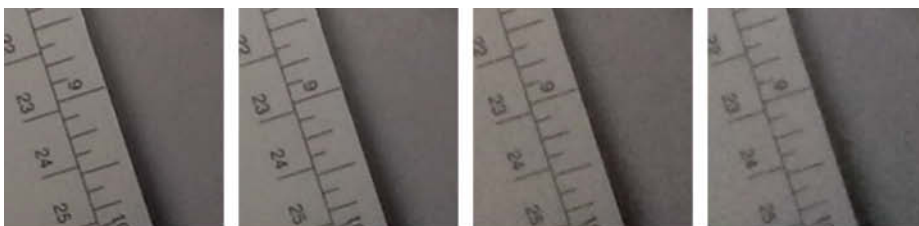
ISO 100   ISO 200   ISO 400   ISO 800
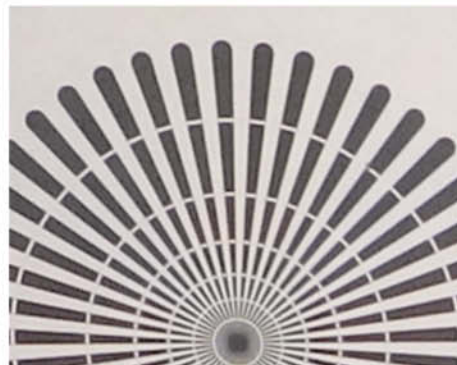
Nikon 1 V1

Compact, mirrorless system camera with 10-megapixel sensor in new Nikon CX format. Includes innovative high-speed video and stills shooting functions.

Good: Robust, easy-to-handle body in rangefinder format with rounded corners. Nikon 1 bayonet with adapter for 35mm system lenses. Compact kit lens. Precise rotary multi selector. Sharp, highly-detailed 921,000-dot monitor. Very good 1.4m-dot electronic viewfinder with infrared proximity sensor. Fast, precise hybrid phase detection/contrast-based AF system. Electronic 10-megapixel burst shooting at up to 60 fps. Quiet shutter. Various high-speed shooting modes including Motion Snapshot (still plus slow-motion video) and Smart Photo Selector mode. Fast data saves. Auto ISO limit user-controllable. Powerful battery with constant reserve power display. Tripod thread located on optical axis.

Not so good: Densely packed CX sensor only half the size of Micro Four Thirds, camera body still as large as MFT competition. No ultrasound dust-off. Four-position mode dial. P/A/S/M settings only accessible via menu system. Main menu somewhat cumbersome. No quick access menu or separate access to main functions. Handling too menu-driven. Poor monitor viewing angle. No flexible programmed auto mode. AF weak in low light and with irritating green assist lamp. No built-in flash. Accessory flash occupies general accessory shoe. Combined battery/memory card chamber too close to tripod thread.

Test results: Medium maximum contrast results, increasing slightly toward ISO 1600. Signal-to-noise characteristics only OK at ISO 100. Visual noise acceptable up to ISO 1600, but more obvious than that of the competition up to ISO 400. Very good central resolution for a 10-megapixel camera, falling off slightly toward ISO 800. Fast startup and very little shutter lag.

Image quality: Bright, mostly correct, very slightly green-tinged colors for the c't test shot in daylight. Consistent, fairly good sharpness that doesn't improve when stopped down. Fairly good central detail rendition. Slightly variable exposure with a tendency to slight underexposure and harsh contrast. Some moirés on our line chart, otherwise none obvious. Some fringing on our sieve. At ISO 100 relatively clean images and edges and good textures but with some slight color inconsistency. Increasingly inconsistent colors at ISO 200/400, otherwise intact. Results at ISO 800 duller with softer transitions and a slight loss of texture and detail. Increasing at ISO 1600 with obvious decrease in sharpness. From ISO 3200 upward, green color cast, loss of detail and obvious noise. Heavily degraded images above ISO 3200

Outdoor color rendition good. Balanced exposure with consistent sharpness and good detail rendition. Wide-angle sharpness and detail not as good. Clean but not entirely noise-free images at ISO 100. Quality OK up to ISO 400, but with decreasing texture and detail thereafter. Acceptable for full-screen display up to ISO 1600.

ISO 100

ISO 400

ISO 1600

ISO 6400
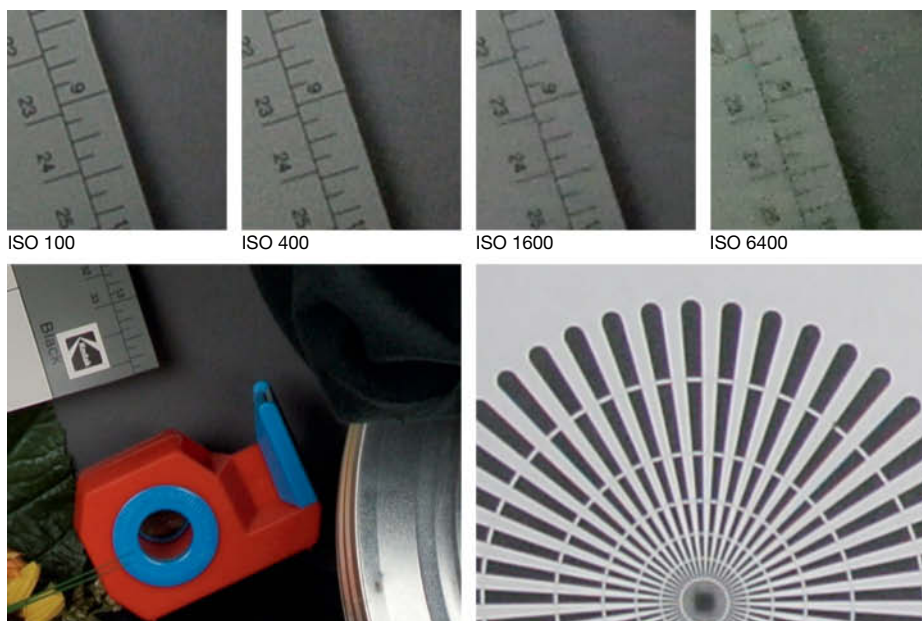
Olympus PEN E-P3

Compact mirrorless system camera with 12-megapixel Micro Four Thirds Live MOS sensor. Built-in flash and very fast autofocus.

Good: Very robust, thin but wide metal body. Removable grip. Live MOS sensor with ultrasound dust-off and three-mode sensor shift image stabilizer. Large, precise rotary main dial. Separate thumb-controlled sub-dial. High-resolution 3-inch OLED monitor with electronic spirit level and 5-14× zoom function. Configurable function buttons. Quick Guides menu and basic touch screen functionality simplify handling. AF precise, even in low light. Kit lens very compact in sleep position. Very fast startup and data saves. Flexible programmed auto mode. Upper auto ISO limit user-selectable. White balance fine-tuning and Kelvin value setting. Fast flash recycle time, preset flash power increments, wireless flash control and TTL flash shoe.

Not so good: Viewfinder optional (optical or electronic). OLED monitor has green cast when viewed from an angle. Controls somewhat small and flat. Improved but still non-intuitive menu system. No constant battery reserve power display. Self-timer not configurable. Combined battery/memory card chamber. Off-center tripod thread. No AC power socket. Future of Olympus uncertain at the time of writing.

Test results: Maximum contrast nearly 'good' up to ISO 800. Good signal-to-noise and visual noise characteristics, falling of rapidly at ISO 1600/3200. 100% central sensor resolution at ISO 200, dropping off only above ISO 400. Fast startup and shortest shutter lag in our test.

Image quality: Bright, consistent but obviously over-warm colors for the c't test shot in daylight, making the test sticker salmon-colored. Sharpness improves by stopping down to f8. Sharpness then consistent with good detail rendition for a 12-megapixel camera. Balanced but slightly variable exposure. Few moirés. Little fringing except for around the test-shot sieve. Clean colors, intact edges and fine textures at ISO 200. ISO 400 performance comparable, but with slightly over-sharp edges and slight loss of texture. ISO 800 less detailed with some washed-out transitions and weaker edges. More obvious quality loss from ISO 1600 upward with green/violet noise artifacts and obvious reduction in detail rendition. Sharpness fall-off at ISO 3200 with dirty-looking luminance noise artifacts. Thereafter verging on unusable.

Outdoor exposure balanced with good color rendition but slightly variable white balance. Sharpness good, although slightly artificial-looking except at wide-angle settings. Good detail rendition and no noise issues up to ISO 400. Reduced detail and slightly duller images at ISO 800, ISO 1600 not appreciably worse and OK for full-screen viewing. Color rendition and edge sharpness drop-off at ISO 3200, images noisy and pale thereafter.

ISO 200

ISO 400

ISO 1600

ISO 12 800
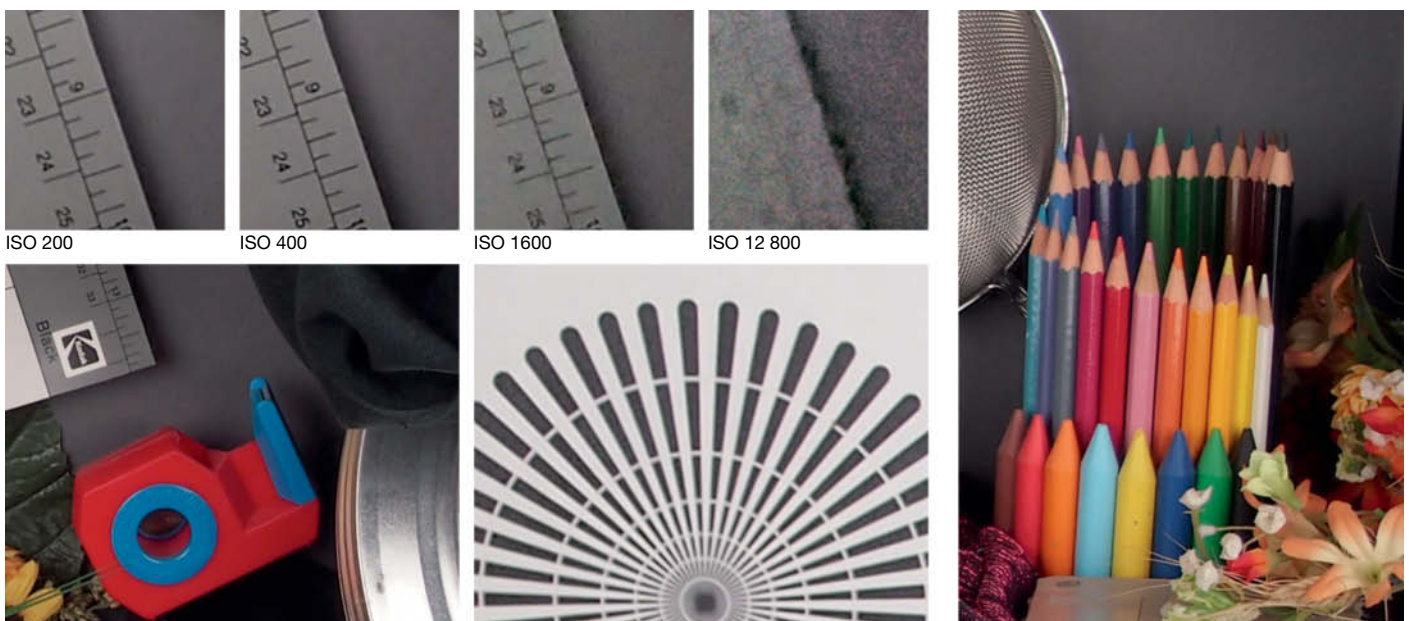
Sony NEX-5N

Mirrorless system camera with very slim body, 16-megapixel APS-C sensor, extremely fast burst rates and 50-fps Full HD video capability.

Good: Light, slim, robust body with large battery chamber/grip. Can also be used with full-frame lenses (with an adapter). Kit lens with smooth, precise adjustment rings. Precise buttons built into control wheel. Vertically tiltable 3-inch 921,000-dot monitor. 187-position single- or multi-area AF fast up to medium focal lengths. Quiet, precise focusing, even in low light. Ten-shot sequences at 10 fps. Very fast data saves. Medium-power accessory flash with fast recycle times included. Compatible with SDHC/SDXC and Memory Stick Duo memory cards. Li-Ion battery with percent-based reserve power display. Tripod thread located on the optical axis. Includes Auto HDR, 3D Sweep Panorama and Anti Motion Blur shooting modes. Built-in Help.

Not so good: Difficult to attach to tripod with larger lenses that protrude beyond the edge of the camera body. Too few controls and no central mode dial. Heavily menu-driven handling. Main menu icons confusingly labeled. Setup menu extremely long and confusing. Gesture-driven touch commands difficult to execute. No quick access menu for major functions. AF continually 'pumps' and is slower at telephoto focal lengths. Expensive accessory viewfinder blocks accessory shoe. Relatively loud shutter. Auto ISO upper limit not configurable.

Test results: Very good maximum contrast at ISO 400 and still good at ISO 3200. Very good signal-to-noise characteristics at ISO 100, still good at ISO 3200. Little visual noise up to ISO 1600. Sensor resolution only 85% over the entire range up to ISO 3200. Fast startup but noticeable shutter lag.

Image quality: Very good, bright color rendition with a very slight yellowy warmth for the c't test shot in daylight. Very good, natural-looking sharpness over the whole frame when stopped down. Detail verging on 'very good' for a 16-megapixel sensor. Balanced but contrasty exposure. Few moirés, some fringing on the test shot sieve. Noise characteristics at ISO 100 flawless and hardly worse at ISO 200, with only slight midtone roughness. Edge definition more pronounced at ISO 400. Images slightly softer overall with slight color noise and less precise outlines at ISO 800. Colors, especially reds, getting dirty at ISO 1600, with color noise artifacts and edge softness increasing at ISO 3200. Results not really usable thereafter.

Outdoor color rendition good, consistently exposed and with good sharpness when slightly stopped down. Minimal noise up to ISO 400, slight texture loss at ISO 800 and reduced detail at ISO 1600. Still good enough for 1:1 viewing. Performance at ISO 3200 generally deteriorates with unusable results at higher values.

ISO 100

ISO 400

ISO 1600

ISO 25 600
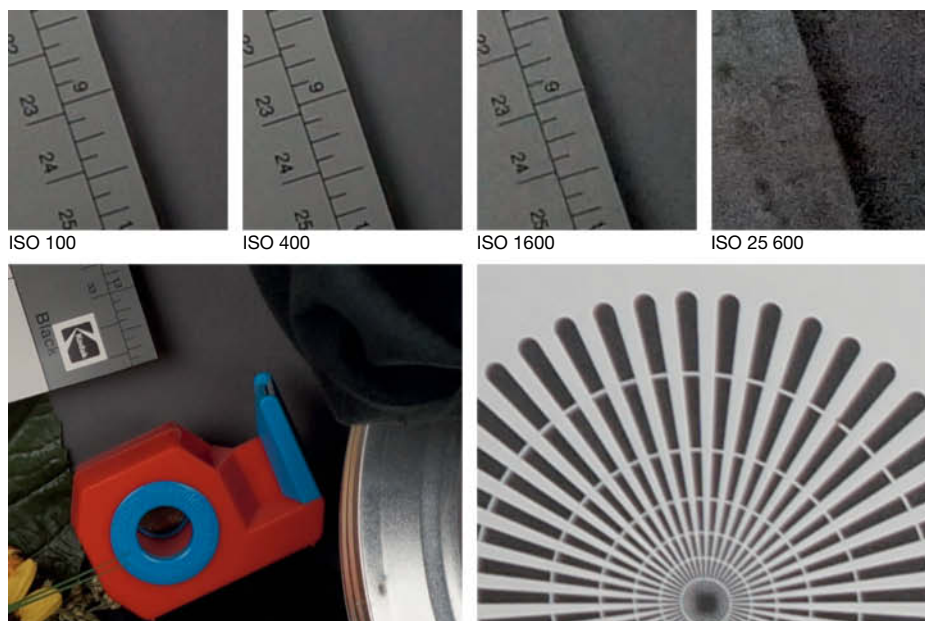
Sony SLT-A77V

Large DSLR with 24-megapixel APS-C senor and fixed, semi-transparent mirror. Extremely high resolution electronic viewfinder, very high burst rate and 50-fps Full HD video capability.

Good: Very robust rubberized weather-proof magnesium body. Shaped grip. Sensor shift image stabilizer. Kit lens with f2.8 widest aperture at all focal lengths and fast ultrasonic motor. Large mode dial, twin control dials, joystick-style multi selector and customizable Fn buttons. Three-inch display rotatable and tiltable around three separate axes. Permanent live view monitor image. 2.4 million-dot OLED viewfinder with instant playback. Clear main menu with scroll-free tabbed navigation. Quick access to major functions via monitor icons. Separate LCD status display panel. Fast constant AF for stills, burst and video shooting. 12-fps burst rate. Auto ISO limit user-selectable. Two programmed auto modes and scene modes that include multi-frame noise reduction. Three white balance presets. GPS. Built-in flash with short recycle time. Wireless flash control. Single-slot SDHC/SDXC and Memory Stick Duo memory card support. Powerful battery and optional vertical battery grip with two additional battery slots.

Not so good: High pixel density. Semi-transparent mirror reduces incident light by 30 percent. Slow shutdown. Non-customizable self-timer. Proprietary (Minolta) flash shoe. Sweep Panorama function not entirely reliable.

Test results: Good maximum contrast up to ISO 800, dropping off markedly above ISO 3200. Good signal-to-noise and visual noise characteristics up to ISO 400 with steep drop-off beyond ISO 800. Test lens only managed 83% of maximum potential sensor resolution, noise artifacts further worsen this behavior beyond ISO 3200. Unremarkable startup time and shutter lag.

Image quality: Bright, slightly yellow-toned colors for the c't test shot in daylight. Good central sharpness and detail rendition but still some softness in the lower corners when stopped down. Only slight moirés on our Siemens Star and line chart. No significant fringing. Noise characteristics faultless at low ISO values and only slightly coarser at ISO 100. Auto noise compensation visible at ISO 200, fine details over-equalized at ISO 400. Smudges begin to appear (especially for red tones) and detail deteriorates beyond ISO 800. ISO 1600 duller with magenta noise artifacts and markedly reduced texture definition. Sharpness drops off rapidly as of ISO 3200 and detail falls off quickly thereafter.

Outdoor color rendition good with consistent exposure. Good sharpness and detail rendition when stopped down over the whole range outside of extreme wide-angle. No significant fringing. Noise characteristics and texture rendition good up to ISO 400, with a reduction in fine detail at ISO 800. Images generally paler with increasing color noise at ISO 1600 and beyond. Patterns with an over-soft 'watercolor' look beyond ISO 3200. Image quality very poor thereafter.

ISO 100

ISO 400

ISO 1600

ISO 16 000
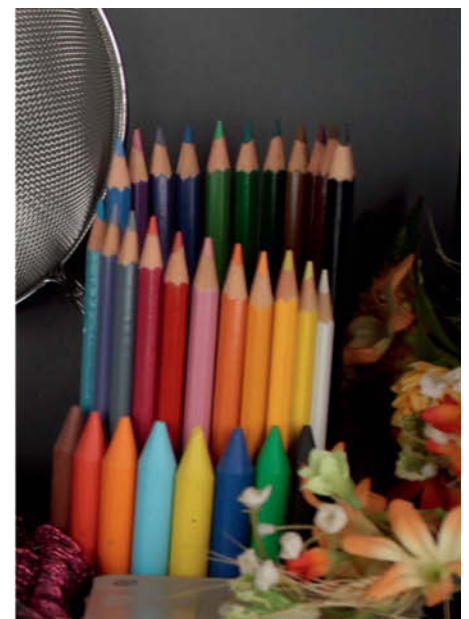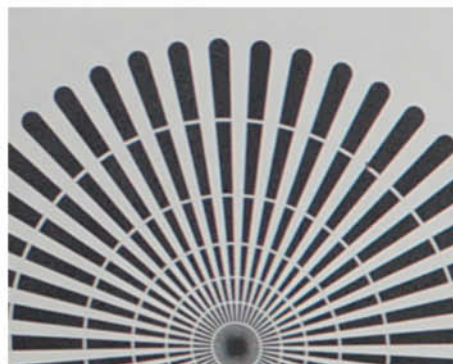
System Camera Overview

Manufacturer and Model	Nikon 1 V1	Olympus PEN E-P3	Sony NEX-5N	Sony SLT-A77V
URL	www.nikon.com	www.olympus.com	www.sony.com	www.sony.com
Digitization				
Native resolutions (in pixels)	3872 × 2592, 2896 × 1944, 1936 × 1296	4032 × 3024, 2560 × 1920, 1280 × 960 (4:3, with 16:9, 3:2, 6:6 and 3:4 selectable)	4912 × 3264, 4912 × 2760 (16:9), 3568 × 2368, 3568 × 2000 (16:9), 2448 × 1624, 2448 × 1376 (16:9)	6400 × 4000, 6400 × 3376 (16:9), 4240 × 2832, 4240 × 2400 (16:9), 3008 × 2000, 3008 × 1688 (16:9)
Sensor type, effective megapixels / Size / Self-cleaning	CMOS, 10 / Nikon-CX (13.2 × 8.8 mm) / − (protective glass)	Live MOS, 12.2 / Four Thirds (17.3 × 13 mm) / ✓	CMOS, 16 / APS-C (23.5 × 15.6 mm) / ✓	CMOS, 24 / APS-C (23.5 × 15.6 mm) / ✓
Image format(s) / Compression rates / Video format	RAW, JPEG, RAW+JPEG / 3 / MPEG-4 H.264	RAW, JPEG, RAW+JPEG / 2 (12-megapixel only) / AVCHD or MJPEG	RAW, JPEG, RAW+JPEG / 2 / AVCHD or MPEG-4 H.264	RAW, JPEG, RAW+JPEG / 3 / AVCHD or MPEG-4 H.264
Video: max. resolution [pixels], length, fps	Full HD 1080p, 20 min., 30	Full HD 1080p, 4 GB or 22 min., 30	Full HD 1080p, approx. 29 min., 50	Full HD 1080p, approx. 29 min., 50
Memory card type / average file size[3]	SD(HC/XC) / 5.9 MB	SD(HC/XC) up to UHS-1 / 5.2 MB	SD(HC/XC) + MS Duo (single slot) / 6.9 MB	SD(HC/XC) up to UHS-1 + MS PRO Duo (single slot) / 18.4 MB
Features				
Crop factor (35mm equiv.) / Bayonet	Approx. 2.7x / Nikon 1 (with adapter: Nikon bayonet)	Approx. 2x / Micro Four Thirds (with adapter: Four Thirds)	Approx. 1.5x / Sony E (with adapter: Sony alpha, Minolta AF)	Approx. 1.5x / Sony alpha, Minolta AF
ISO settings	Auto (100-400/800/3200), 100-3200 (6400) in 1/1 steps	Auto (limit user-selectable), 200-12 800 in 1/3 or 1/1 steps	Auto (100-3200), 100-25 600 in 1/1 steps	Auto (limit user-selectable), 50-16 000 in 1/3 steps
Shutter speeds [s] / Default flash sync [s]	Bulb, 30-1/4000 / 1/250	Bulb, 60-1/4000 / 1/180	Bulb, 30-1/4000 / 1/160	Bulb, 30-1/8000 / 1/250
Focusing / Image stabilizing	Hybrid-AF (one-shot, continuous, tracking), MF / ✓ (VR lenses)	AF (one-shot, continuous, face-detection), MF / ✓ (sensor shift)	AF (one-shot, continuous, tracking, face-(re)detection), MF / ✓ (lenses)	AF (one-shot, continuous, tracking, face)detection, eye-start), MF / ✓ (sensor-shift)
AF areas / Focus assist lamp	41 or 1 (135 positions) / ✓ (green)	35, 9 (15 positions) or 1 (35 positions) / ✓ (red)	25 or 1 (187 positions) / ✓ (red)	19 (11 cross sensors), groupable / ✓ (red, striped)
Metering: Matrix / Center-weighted / Spot	✓ / ✓ / ✓	✓ / ✓ / ✓	✓ (1200 zones) / ✓ / ✓	✓ (1200 zones) / ✓ / ✓
Programmed auto / Scene modes / Custom presets	✓ / ✓ (scene recognition only) / −	✓ (with shift) / 24 / ✓ (4 presets)	✓ / 11 / −	2 (with scene recognition) / 8 / 3
Exposure: Aperture priority / Shutter priority / Manual	✓ / ✓ / ✓	✓ / ✓ / ✓	✓ / ✓ / ✓	✓ / ✓ / ✓
Exposure compensation [EV] / Depth-of-field preview	±3 EV in 1/3 steps / −	±3 EV in 1/3, 1/2 or 1/1 steps / − (via Fn2 assignment)	±3 EV in 1/3 steps / −	±5 EV in 1/3 or 1/2 steps / ✓ (electronic preview)
Bracketing: Exposure / WB / Focus / Interval timer / Sound	− / − / − / ✓ / ✓ (16-bit, stereo, 48 kHz)	✓ (+ ISO bracketing) / ✓ / − / − / ✓ (16-bit, stereo, 48 kHz)	✓ / − / − / − / ✓ (16-bit, stereo, 48 kHz)	✓ (single or sequence) / ✓ (+ HDR bracketing) / − / − / ✓ (16-bit, stereo, 48 kHz)
Self-timer / Continuous shooting speed, # of frames[6]	10, 5 or 2 s / 60 fps, 30 shots	10 or 2 s / 3 fps, approx. 17 shots	10 or 2 s or smile detection / approx. 10 fps, 10 shots	10 or 2 s or smile detection / 12 fps, 13 shots
White Balance: Auto + Man. / Presets / Fine-tuning	✓ / 6 / ✓	✓ (manual: 2 presets) / 6 / ✓ (and Kelvin values)	✓ / 9 / ✓ (and Kelvin values)	✓ (manual: 3 presets) / 9 / ✓ (and Kelvin values)
Sharpness, Contrast, Saturation adjustable / Color spaces	✓ / sRGB, Adobe RGB	✓ / sRGB, Adobe RGB	✓ / sRGB, Adobe RGB	✓ / sRGB, Adobe RGB
Viewfinder: Type / Magnification / Coverage	electronic (1.4 megapixels) / k. A. / 100 %	− (optional electronic or slot-in) / − / −	− (optional electronic or slot-in) / − / −	electronic (2.4 megapixels) / 1.09x / 100%
Monitor: Diagonal / Resolution [dots] / No. of brightness settings	3-inch / 921,000 / 7	3-inch touch screen (OLED) / 610,000 / 5 (+ color temperature)	3-inch touch screen (vert. tiltable) / 921,600 / auto, sunshine or 5	3-inch (adjustable around 3 axes) / 921,600 / auto or 5
Live View / With AF using sensor / Dedicated sensors	✓ / ✓ / ✓	✓ / ✓ / −	✓ / ✓ / −	✓ / − / ✓ (semi-transparent mirror)
Body material / Control panel / Auto monitor rotations	Metal + plastic / − / −	Metal / − / −	Metal / − / −	Magnesium / ✓ (can be illuminated) / −
4-way selector / Multi selector / Command dials	✓ (+ OK button) / 1 / 1 (ring around 4-way selector)	✓ (+ OK button) / 1 / 2 (1 is a ring around the 4-way selector)	✓ (+ center button) / − / 1 (rotary 4-way selector)	✓ (mini joystick) / 2 / 2
Flash guide number (ISO 100) / Charge time / Connector	− / − / ✓ (proprietary accessory shoe)	10 (ISO 200) / 3.8 s / ✓ (TTL shoe)	7 (accessory flash) / 2.3 s / ✓ (proprietary accessory shoe)	12 / 3.5 s / 2 (TTL shoe, X-sync socket)
Playback				
Multiple [# of images] / Zoom / Histogram	72, 9 or 4 or calendar / ✓ / ✓	100, 25, 9 or 4 or calendar / ✓ (up to 14x) / ✓ (with RGB)	12 or 6 / ✓ (up to 14x) / ✓ (with RGB)	9 or 4 / ✓ (up to 13.6x) / ✓ (with RGB)
Connectors / Dimensions				
Power source	AC adapter (proprietary), rechargeable Li-Ion battery	Rechargeable Li-Ion battery	AC adapter (proprietary), rechargeable Li-Ion battery	AC adapter (proprietary), rechargeable Li-Ion battery, optional vertical grip with two battery slots
Interfaces / A/V out / HDMI / Printer	USB 2.0 / ✓ (+ Mic. in) / ✓ (Type C) / ✓ (IR)	USB 2.0 / ✓ / ✓ (Type C) / −	USB 2.0 / − / ✓ (Type C) / ✓ (IR)	USB 2.0 / − (+ Mic. in) / ✓ (Type C) / ✓ (IR or cable)
Dimensions (W/H/D) / approx. weight[6] Body only / With test lens	113 mm × 76 mm × 44 mm / 385 g, 500 g	122 mm × 70 mm × 34 mm / 385 g, 495 g	111 mm × 60 mm × 38 mm / 265 g, 460 g	143 mm × 104 mm × 81 mm / 740 g, 1320 g
What's in the Box				
Manual / User guide	User manual	User manual	User manual	User manual
Accessories	Li-Ion battery EN-EL15 (7 V, 1900 mAh, 14 Wh), charger, body cap, shoulder strap, USB and AV cables, kit lens	Li-Ion battery PS-BLS1 (7.2 V, 1150 mAh, 7.8 Wh), charger, body cap, shoulder strap, USB and AV cables, kit lens (if applicable)	Li-Ion battery NP-FW50 (7.2 V, 1020 mAh, 7.3 Wh), charger, accessory flash HVL-F7S, body and viewfinder caps, shoulder strap, USB cable, kit lens (if applicable)	Li-Ion battery NP-FM500H (7.2 V, 1600 mAh, 11.5 Wh), charger, body and viewfinder caps, shoulder strap, USB cable, kit lens (if applicable)
Software				
Standalone software (platform)	Nikon ViewNX 2, Short Movie Creator (Win/Mac)	Olympus ib (Win)	Picture Motion Browser 5.5 (Win), Image Data Suite (Win/Mac)	Picture Motion Browser 5.8 (Win), Image Data Converter SR 4.0, Image Data Lightbox SR (Win/Mac)
Ratings				
Test images[1] (c't test image shot in daylight)	Shot using a 1 NIKKOR VR 10-30mm f/3.5-5.6	Shot using an M. ZUIKO DIGITAL 14-42mm f/3.5-5.6 II R	Shot using an SEL 1855 18-55mm f/3.5-5.6	Shot using a Sony 16-50mm f/2.8-22
Color rendition / Exposure	⊕ / ⊕	○ / ⊕	⊕⊕ / ⊕	⊕ / ○
Sharpness / Detail rendition	○ / ○	⊕ / ⊕	⊕ / ⊕⊕	○ / ⊕⊕
Image noise / Other artifacts[2]	○ / ⊕	○ / ⊕	⊕ / ⊕	⊕ / ⊕
Ease of use / Printed manual	○ / n/a	⊕ / ⊕	○ / ⊕	⊕⊕ / n/a
Feature set[4,5] / Included accessories[4]	○ / ○	⊕⊕ / ○	⊕ / ○	⊕⊕ / ○
RRP: Body only / With test lens (US$)	− / 870	− / 799	600 / 700	1400 / 1999

[1] Judged by eye on a calibrated monitor (applies only to these cameras and therefore not comparable with earlier tests)
[2] Sharpening and compression artifacts, noise, moirés, color fringing   [3] Average value, measured using largest native image size and best JPEG quality
[4] Relative to similar class of camera   [5] Photographic features only   [6] Measured values

c't

André Kramer

Free RAW Processing with

RawTherapee

Even the best photos can always be made to look a little better. RawTherapee (included on this issue's free DVD) is a donationware RAW developer bursting with features. This article guides you through the various available options and shows you that a few carefully selected tweaks and sound judgment are all you need to make your friends and colleagues green with envy at your photographic prowess.

Initial Diagnosis

The first step in correcting an image is to determine which errors are present, and before you do anything else at all, you should check that the horizon is horizontal. It is very easy to shoot on a slant, especially if you are using a compact camera. If it is not a deliberate element of a photo's composition, skewed alignment needs to be fixed.

In terms of image composition, lines that lead the viewer's eye from the lower left to the upper right corner of the frame are perceived as having a positive effect, while lines that lead from top left to bottom right are somehow perceived negatively. Even the most beautiful beach begins to conjure up negative emotions if the horizon looks like a graph of the Dow Jones index on Black Friday, whereas a positive 'rising' horizon is tolerable if there is no practical way to retouch it.

As a first step in the optimization process, **cropping** is a simple way to remove distracting details and alter the aspect ratio of an image.

Adjusting colors is a more complex process. The first thing to do is to check and, if necessary, adjust the **color temperature** of your image. People generally tend to prefer looking at 'warm' colors, so even if your camera's automatic exposure systems have overcooked the glow of a portrait taken at sunset, you don't have to cool down its look just because it looks slightly surreal. Conversely, photos of people taken in 'cool' neon light nearly always benefit from a slight shift toward the warm end of the color temperature scale.

You can now devote your attention to adjusting **exposure**. Is your image bright enough? Or perhaps even too bright? Generally, all relevant details should be easily recognizable, although a silhouetted subject can also be an effective eye-catcher.

Contrast plays a significant role in the effect an image has on the viewer, but not all subjects are suited to portrayal in a high-contrast style. Generally speaking, black-and-white images portray a large range of contrast better than color photos. Artistic portraits can benefit from a high-contrast style, too, whereas photos of children are much more effective if you stick to a low-key, low-contrast approach.

One of the trickiest settings to make is the level of **color saturation** in your images. Completely desaturated colors become grayscale tones and produce black-and-white images, while highly saturated colors give an image an over-the-top 'bubble-gum' look. The settings you choose are largely a matter of taste.

The final step in the processing chain is image **sharpening**. The amount and type of sharpening you apply depends more on the output medium than the content of the photo itself. Most images require much less sharpening to be viewed effectively on a monitor than they do if they are to look good in print.

There is also a wide range of optional **effects** that you can apply to attract a viewer's attention, such as borders or vignettes.

Open File Surgery

If you are serious about editing your photos, you should do so in RAW format if possible. RAW gives you at least 12 bits of image data (i.e., 4,096 different tonal values) per color channel to play with, which is significantly more than the 256 values per channel available in JPEG image files. Additionally, any processing steps you apply will exaggerate the compression artifacts present in JPEG images.

To make the most of the processing potential offered by RAW image formats, you need to process them using software that supports 16 bpc (bits per color channel) processing. 8-bpc processing is equivalent to using JPEG image data and makes using RAW images redundant. Two hundred and fifty-six different tonal values may sound like a lot, but as soon as you begin to selectively edit shadow or highlight areas in an image, you will be working within a relatively narrow range of less than 50 tonal values. Consequently, unless you expand the tonal curve for the full tonal range, you run the risk of creating blocky, pixelated transitions between colors. This type of effect is often seen in heavily compressed images of subjects that display fine tonal differences, such as the sun shining through mist.

Unfortunately, only a few conventional image processing programs support true 16 bpc processing. However, RAW converters are a different ball game, and offer a wide range of ways to make significant adjustments to your images. RAW converters also make it much quicker to process large numbers of image files.

The processing engine built into the current version of *RawTherapee* processes images exclusively on a 16-bpc level and only reduces bit depth when exporting finished images. The program can also save PNG- and TIFF-format images directly to 16-bit. It supports most current RAW formats and can process JPEG images too.

Program Overview

By default, *RawTherapee* starts in File Browser mode. The program doesn't offer

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It isn't difficult to see when a photo doesn't look quite right, but working out exactly what needs adjustment and knowing which tools to use to improve things is a real art. Even if there is no ideal way to correct a photo, the process can still be broken down into a few basic steps that you can rely on to give your photos that certain extra something.

Not every photo will benefit from all of these processing steps, but the right combination will usually suffice to make just about any image presentable. If your camera supports RAW capture, you should always use it if you want to give yourself the greatest possible flexibility when it comes to tweaking your images later. But even pre-compressed JPEGs can be improved using some or all of the steps described below.

RAW development software is the modern way to process digital images quickly and effectively, and you don't have to use pro-grade packages like *Lightroom*, *Bibble* and *Aperture* to get to grips with the techniques involved. The 3.0 version of the open source *RawTherapee* package is the first that is really comparable with the commercial competition in terms of image correction quality. This workshop uses *RawTherapee* to take you through the entire post-processing workflow.
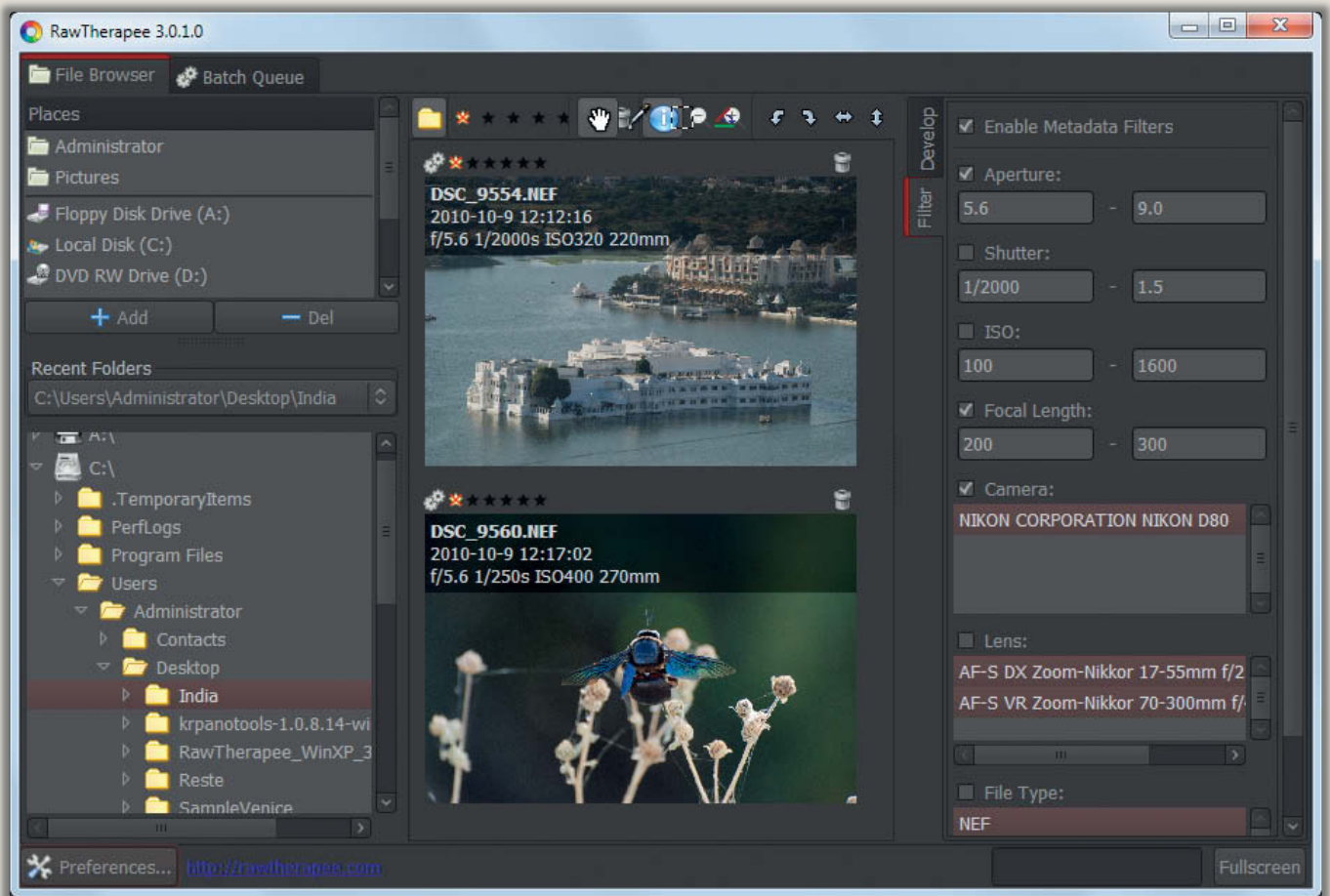
The Filter view in the main program window makes it simple to find photos that meet certain criteria, such as all photos shot using a telephoto lens or at high ISO values

A range of user-selectable guides, such as the Golden Ratio shown here, help you to adjust your composition effectively
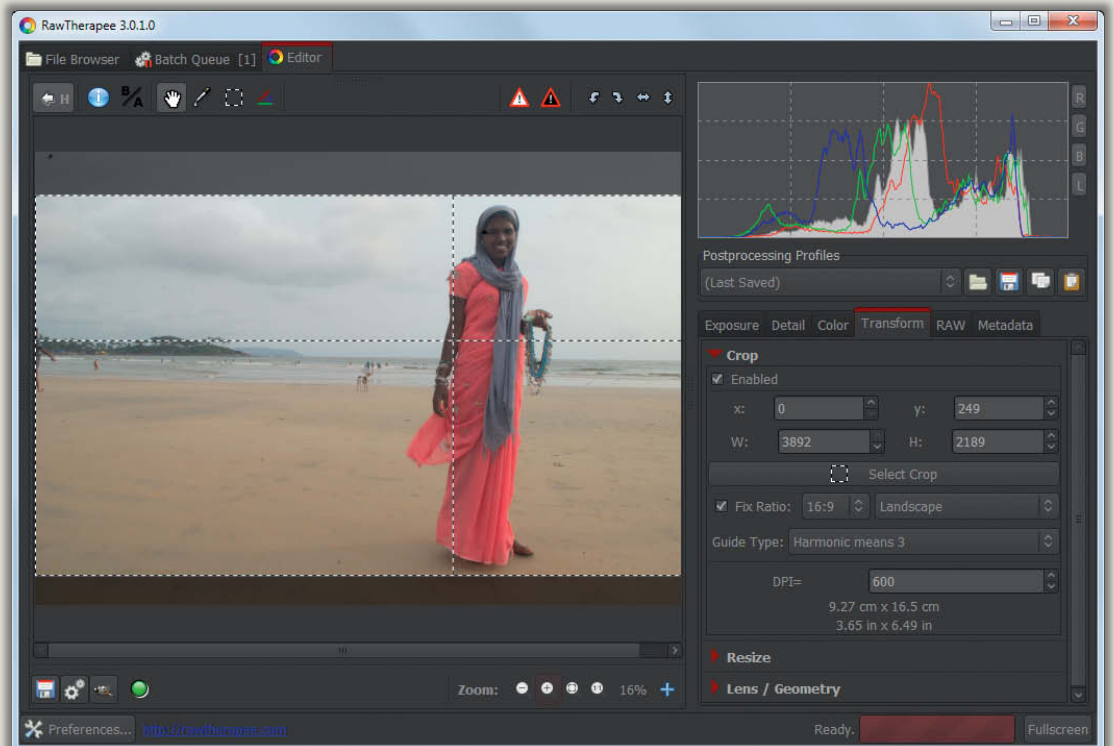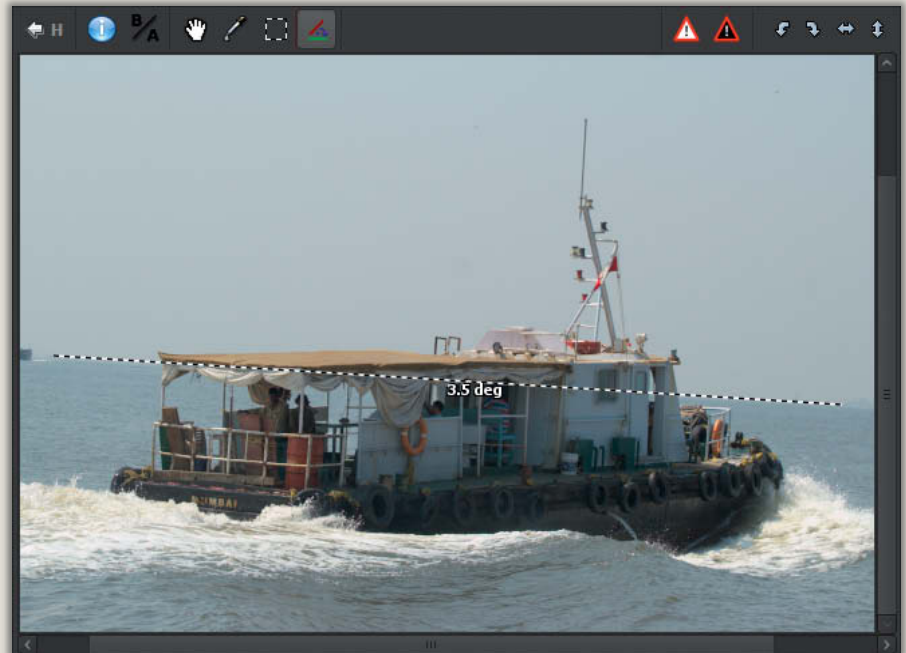
comprehensive metadata management functionality, but does show large thumbnails of the files stored in the current folder. Even in File Browser view, the tool panel is displayed on the right of the preview window, so you can start correcting your images right here if you wish, although the Editor view gives you a larger preview and a better overview of the available tools. The Filter panel is a fantastic tool that makes searching for images based on individual Exif metadata fields quick and easy – for example, if you need to find all images in a folder that were taken using a telephoto lens.

Double clicking an image opens the Editor window, which includes a tab that shows all currently open images and a toolbar with the most impotant tools. The right-hand side of the window is dedicated to the Develop panel, which is divided into Exposure, Detail, Color, Transform and RAW tabs. The diskette button opens the Save dialog, which offers JPEG, TIFF and PNG file formats.

RawTherapee **automatically aligns slanted vertical and horizontal lines to match a user-defined reference line and crops the results**

Image Alignment

Spontaneous snapshots often capture a moment creatively without much regard for image composition, while subsequent analysis on a computer reveals many of their shortcomings.

The first thing you should check is the alignment of the horizon and vertical lines in things like buildings and doorframes. If these are not parallel to the edges of the image, you will (in most cases) need to realign them. *Photoshop* and many of its imitators use a tool with a manually entered number of degrees to rotate images, but *RawTherapee* goes one better. Clicking the far right-hand button in the toolbar or pressing the **S** key activates the *Straight line selection* tool, with which you can simply drag a line through the image – the program then automatically aligns the image to the line, depending on whether it is closer to the vertical or horizontal axis, and crops the resulting frame.

Once you have aligned an image, you can crop it to remove any unwanted details or simply to improve its overall composition. Thanks to modern multi-megapixel sensors
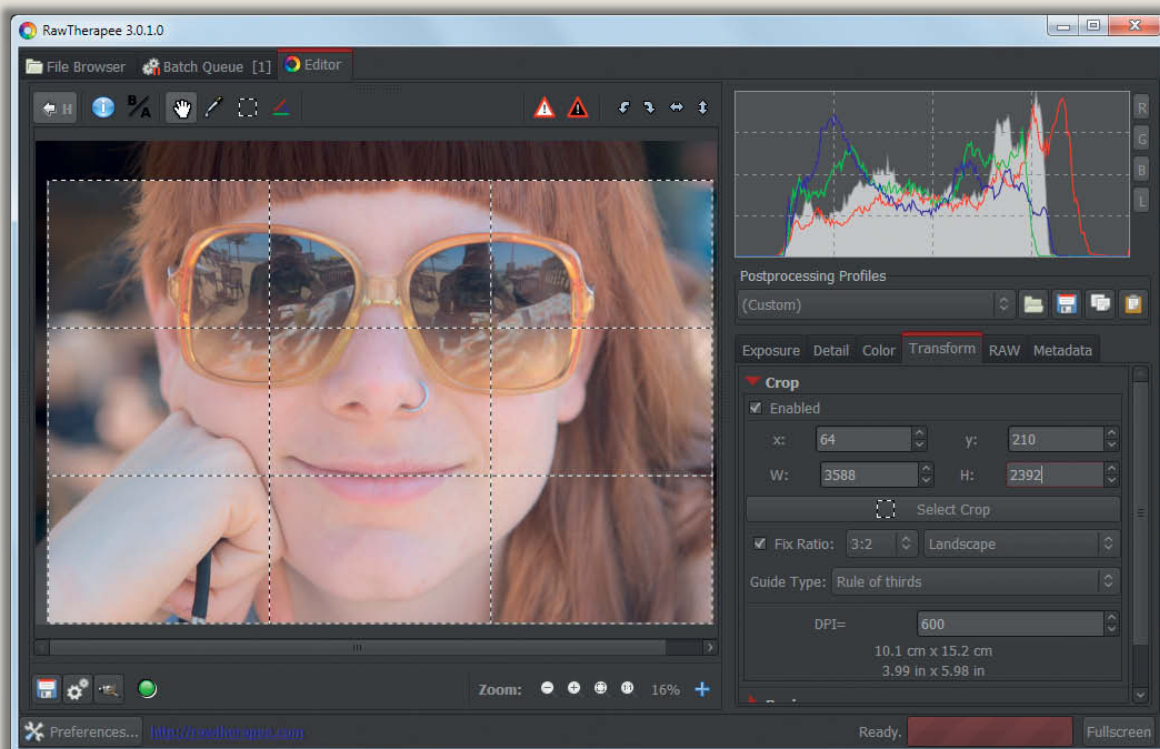
Perfect symmetry. *RawTherapee* **offers a range of alignment grids including one that divides the frame according to the Rule of Thirds.**

Automatic exposure systems often select incorrect white balance settings, especially in artificial light. Once again, *RawTherapee* comes to the rescue!

The Spot WB tool in the White Balance section of the Color tab allows you to precisely select a reference point for the overall white balance in an image. The Color tab also includes a Temperature slider for fine-tuning the results of white balance adjustments.
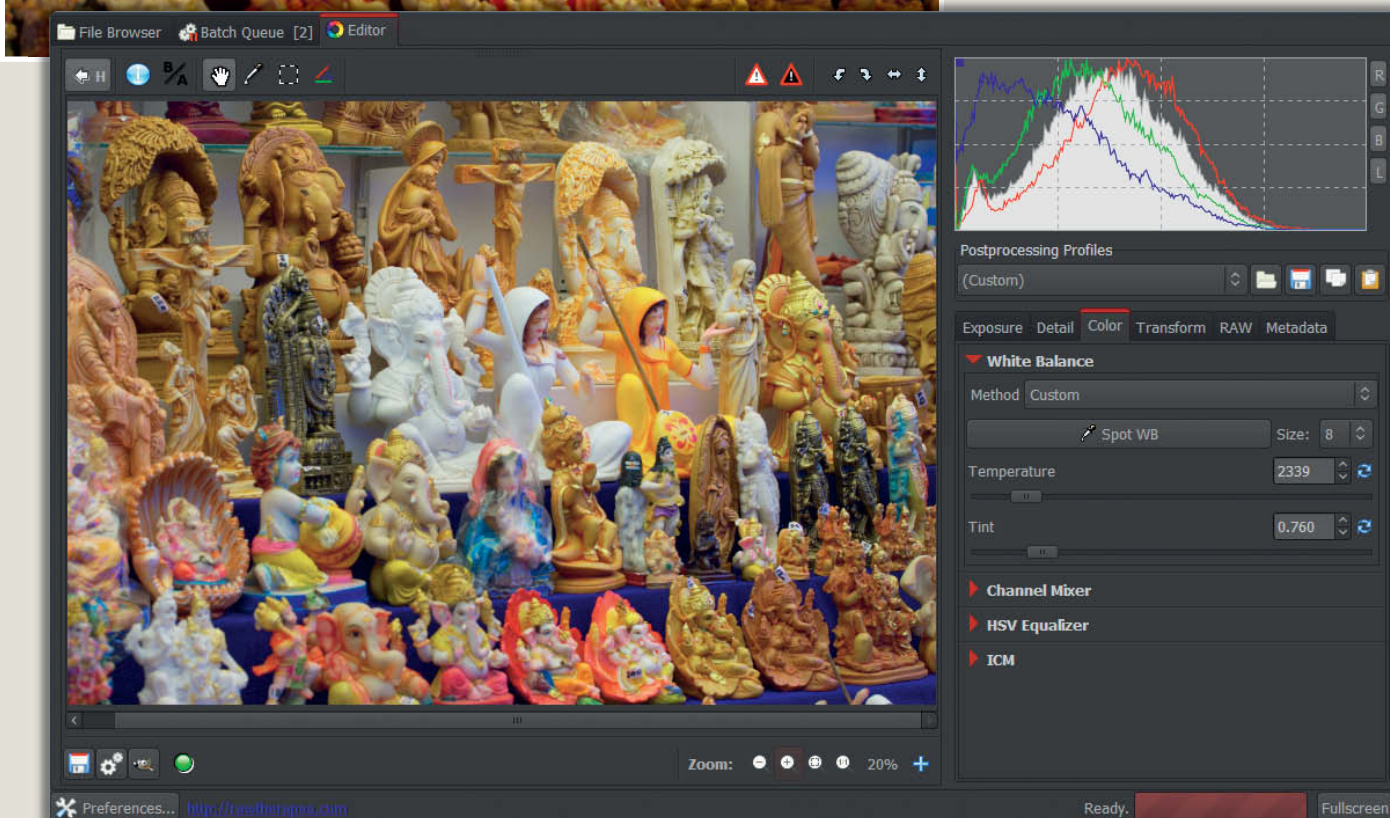
and super-sharp lenses, cropping nowadays rarely involves compromising image quality.

Cropping

The Transform tab contains a highly flexible cropping tool that includes settings for various preset aspect ratios, including the 3:4 ratio common to many compact cameras and the 2:3 ratio used by most DSLRs.

If you are processing images for printing, the 2:3 DSLR format is often a good choice, as many photo labs offer their best deals on 10×15 or 20×30 cm prints. However, if you plan to view your photos on a TV or using a projector, you can select the common 16:9 format instead. This uses the screen's pixels to the max and prevents your images from showing black borders.

The Crop menu also includes various guides to help you crop your images accurately. These include a number of variations on the Golden Ratio and also a Rule of Thirds grid, which means you can crop your images according to the rules of classical aesthetics without having to study the history of art first. Many hobby photographers and beginners make the mistake of positioning the main subject in the very center of the frame, although shifting it slightly to the left- or right-hand third of the available space usually produces a more pleasing image. It is nearly always better to shift a portrait subject's head further up the frame than your initial glance would suggest – otherwise, the top half of

the frame will contain just sky while your subject's legs will most likely be chopped off at the bottom.

Cropping is the simple solution to many framing errors, and you can adjust the size of the crop frame size by grabbing its edges with the mouse and dragging it. If you have selected a fixed aspect ratio, dragging an edge automatically adjusts the positions of all four edges. You don't actually have to confirm a crop, as *RawTherapee* automatically includes the crop frame when you save an image.

Color Corrections

Human vision is at best a 50 percent optical process, and our brain does most of the hard work of interpreting what we see. We tend to perceive a white wall as being white, regardless of the color temperature of the light source illuminating it. The automatic white balance function built into most digital cameras attempts to do the same, but with differing degrees of success – the result is often an image with an obvious color cast.

Correcting color casts using curves and sliders is virtually impossible and many entry-level image processing programs don't offer any solutions to this type of problem at all. RawTherapee, on the other hand, includes the eyedropper-based *Spot white balance* tool that lets you precisely select an area within your image that you want to use as a neutral gray reference point. The software then adjusts all the other colors in the image to match your selected gray point.

Left:
An attractive subject that has been hopelessly underexposed. However, this doesn't have to mean that the image is destined for the trash

Below:
***RawTherapee* retrieves vivid colors from our poorly exposed snapshot. The photo can easily stand being brightened by 1½ stops.**
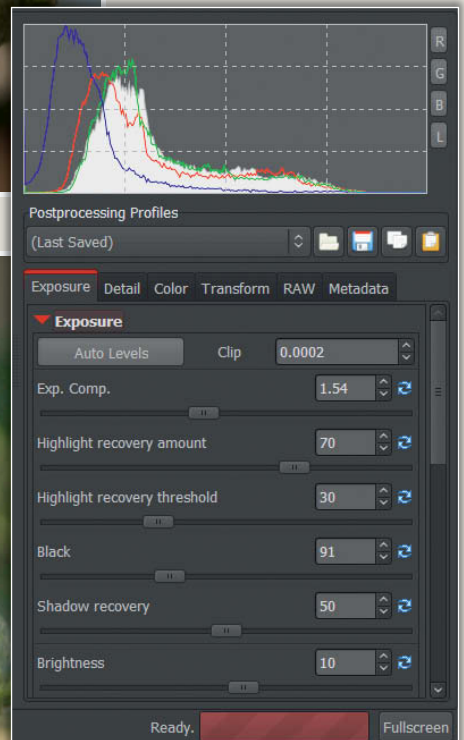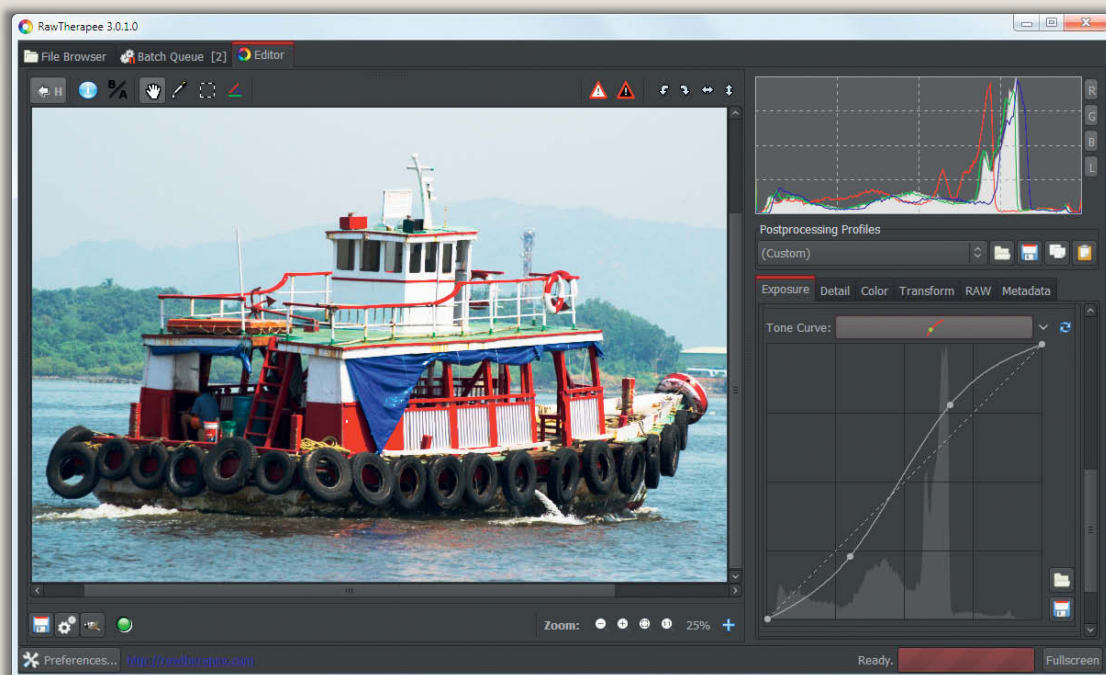
Curves give the user complete selective control over brightness corrections in the highlights, midtones and shadows. A moderate S-curve like the one shown here increases overall contrast.

Automatic exposure systems often produce color errors for warm tones, making them appear too cool. You can correct this type of error manually using the tools contained in the Color tab. The Temperature slider is particularly interesting – just a slight shift to the right makes an image look much warmer, but take care not to overdo things, as the effect can quickly become overbearing.

Experience has shown that it is better to use automatic white balance settings and fine-tune the results using very slight manual adjustments, rather than simply applying random settings using the slider.

Brightening

The photo on the previous page has all the basic elements of a great image: a pleasing subject, plenty of shadow, midtone and highlight detail, and bright colors. The original shot was very underexposed and actually looks dull and slightly depressing. Fortunately, it was shot using a Nikon DSLR and saved in

Nikon's proprietary 'NEF' RAW format, giving it plenty of editing potential.

It is not difficult to increase exposure in a RAW image by as much as 1½ stops. In fact, many photographers prevent burned-out highlights by deliberately underexposing their RAW images and correcting them later. This still provides enough shadow detail to work with, and our brightened sample photo looks much better than the original. If you activate the *Clipped highlight* and *Clipped shadow* warning signs at the top right-hand
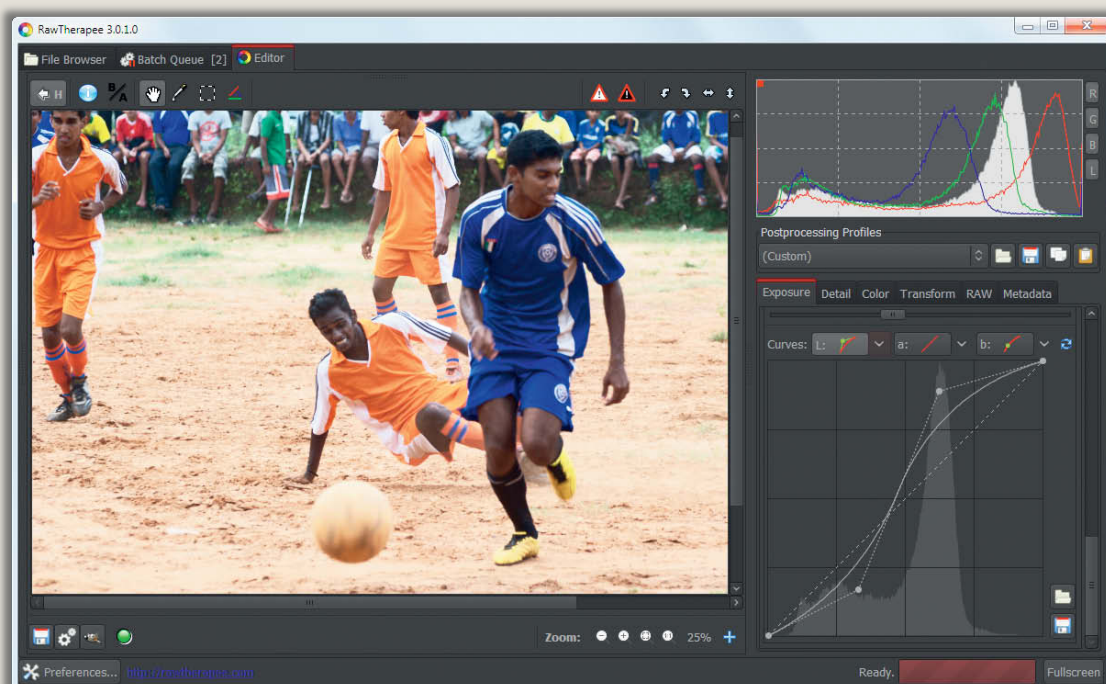
Control Cage (or 'NURBS') curves produce sharp contrast without swamping shadows or burning out highlights.
They are a great tool for practising using curves.
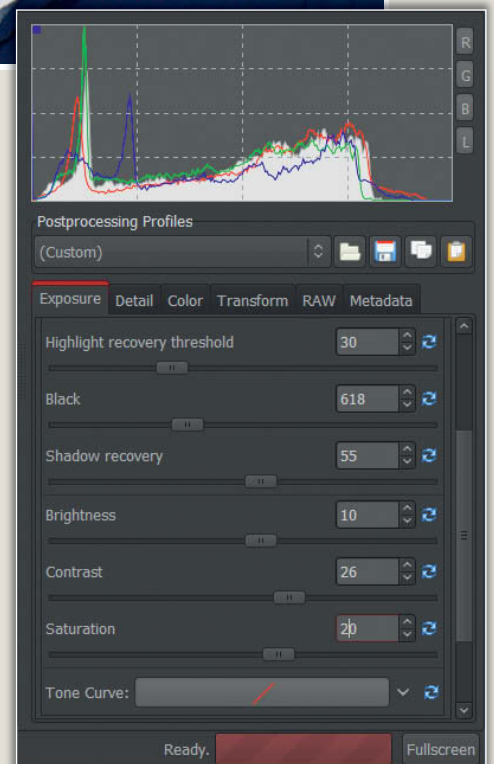
Take care when adjusting saturation. You can adjust it subtly for bright colors using the Lab Adjustments Saturation slider.

corner of the Editor preview window, any burned-out highlights or swamped shadows will be indicated in the appropriate place on the image, preventing you from overdoing your adjustments. If the highlights suffer more than the rest of an image during processing, you can retrieve some highlight detail using the *Highlight recovery* slider. You can then increase the *Black* level slightly to reinstate any contrast that might have been lost during the previous steps.

Lab-mode Curves

Sliders offer a simple, linear approach to making adjustments, even if it is not quite clear what is going on behind the scenes. It is all too easy to produce black or white areas where there used to be detail, and your mistakes often only become visible once you have printed an image. For example, the Brightness/Contrast tool built into early *Photoshop* versions (i.e., before the introduction of CS3) was based on a linear function that simply chopped off black or white areas during tonal adjustments. Later versions of the tool compress tonal values in a smarter fashion that prevents harsh image quality loss. The user still only sees a single slider and has to have faith in the software programmers' art.

However, if you use curves to edit your images, you take over control of the process yourself. Most image browsers, converters and processing programs include curves tools that apply changes to the RGB (red, green and blue) color channels, either separately or all at once. The disadvantage of this system is that using it to adjust brightness or contrast automatically affects color saturation too.

Once again, *RawTherapee* has an answer, this time in the form of Lab-mode curves. The Lab color model consists of a luminosity channel, **L**, that contains only brightness values (from 0/black to 100/white) and two color channels called **a** (red/green) and **b** (yellow/blue). These represent a color-opponent space based on the idea that the colors bluish-yellow and reddish-green simply don't exist.

Lab-mode curves allow you to adjust the brightness of an image without affecting the colors at all – an approach that is simply not possible using the RGB color model.

The *RawTherapee* Lab Curves tools are located at the bottom of the Exposure tab and offer three drop-down menus with four curve types for each of the three channels. The default setting for the drop-downs is Linear, which equates to 'unprocessed'. To adjust

brightness or contrast without affecting the colors in your image, all you have to do is adjust the curve for the L channel.

Custom is the most manipulable of the curve types on offer and allows you to set control points using mouse clicks and manipulate the curve by moving them around the graph. Shadow values are on the left-hand side, midtones in the center and highlights on

the right. Dragging the curve upward in any of these regions brightens the related tonal values, while moving it downward darkens a region. The subtle shape of the curve is perfect for making balanced adjustments, in contrast to simply adjusting the gradient of the linear curve, which would immediately clip the shadow and highlight values.

A slight S-curve increases overall contrast by darkening the shadows and brightening the highlights but, unlike a simple slider, gives you individual control over the strength of the effect you apply to each region. If you have set too many control points, you can delete them by dragging them out of the dialog box. Keep the shadow and highlight clipping indicators switched on and make sure that you don't over-adjust by more than just a few pixels if you can.

The Parametric curve type lets you adjust your image using sliders called Highlights, Lights, Darks and Shadows. Lights and Darks represent slightly larger regions than Highlights and Shadows at the ends of the tonal curve.

The limits set using the sliders are visible on the curve and prevent you from unintentionally clipping any tonal values. This is the same approach that *Lightroom* uses in its Curves tool.

If you are not very confident with curves, Control Cage mode is great for practising. Control Cage curves are also known as NURBS (Non-uniform Rational B-Spline) curves and guarantee a curve with soft peaks and troughs and no sudden swerves of the kind that are (too) easy to produce in Custom mode. In other words, NURBS curves make it more difficult to produce over-the-top results.

The histogram at the top right-hand corner of the program window gives continuous real-time feedback on the changes you make. You should always aim to form a smooth peak in the center of the x-axis. Jagged peaks that are too close to one end of the graph indicate that parts of the image are probably damaged.

Saturation

Adjusting saturation in digital images is not a simple matter. Generally, an image will look better if you aim to accentuate the colors that are already present rather than changing them to make them brighter.

For example, blue and brown shadows are not the defining element of an image of a castle wall showing grooved stone and arrow slits, but the image can benefit enormously from a black-and-white conversion that accentuates the texture and contrast within the subject. On the other hand, a little enhancement of the bright colors that are present in an image of a cloth market in India is entirely appropriate. As ever, it's all a matter of personal taste and your own creative approach – these are all just ideas to get you started producing your own image enhancements.

Used in isolation, most saturation slider adjustments cause more harm than good, whereas a slight increase in the Black slider value in the Exposure tab simultaneously increases contrast and color intensity, which is a really useful combination. The best tool for increasing the intensity of bright colors is the Saturation slider in the Lab Adjustments section of the Exposure tab.

The image below left, with its gray sky and dirty brown water, contains almost no color values, but the backlight produces strong contrast in the texture of the mud on the river bank. This type of image is perfect for applying a saturation value of zero – in other words, completely desaturating the colors and converting it to black-and-white.

Sharpening

Once you have finished editing an image, it will usually require output sharpening. The
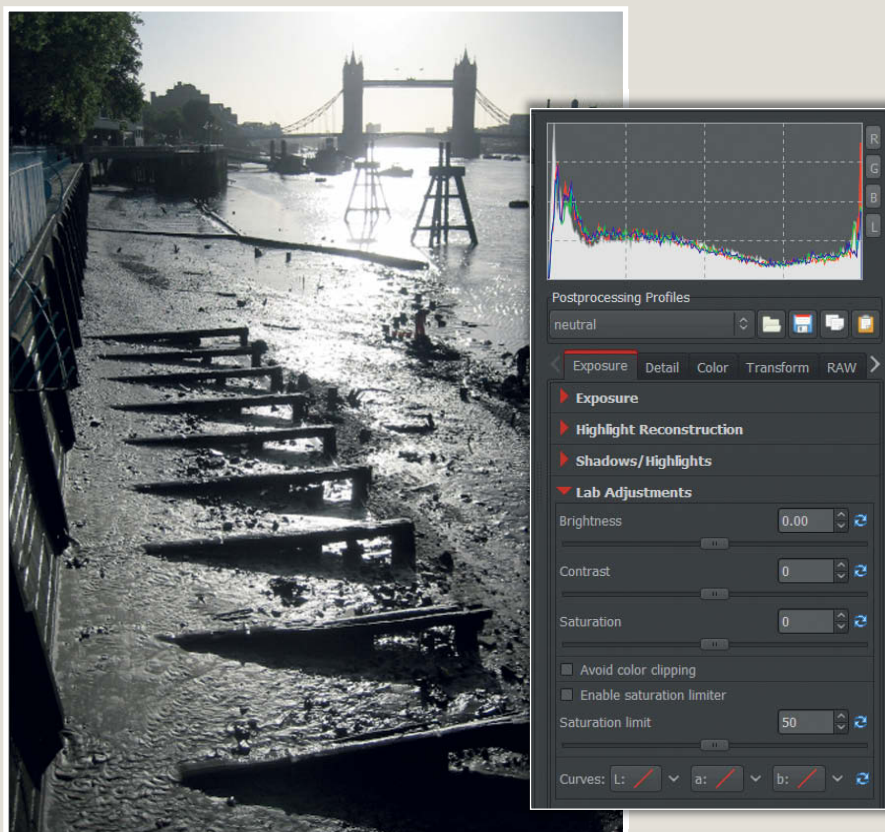
Photos that display lots of texture and strong contrast but little color simply beg to be converted to black-and-white
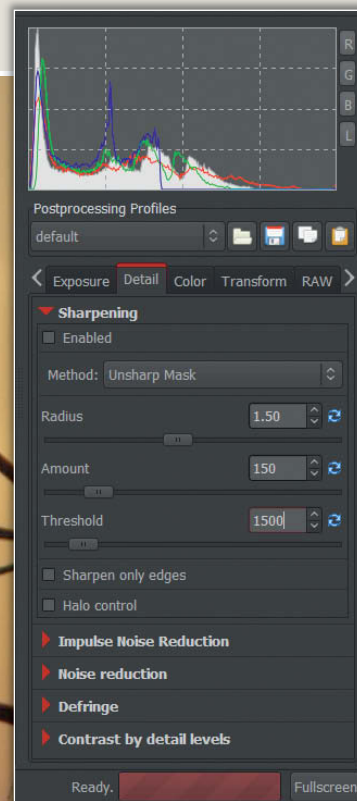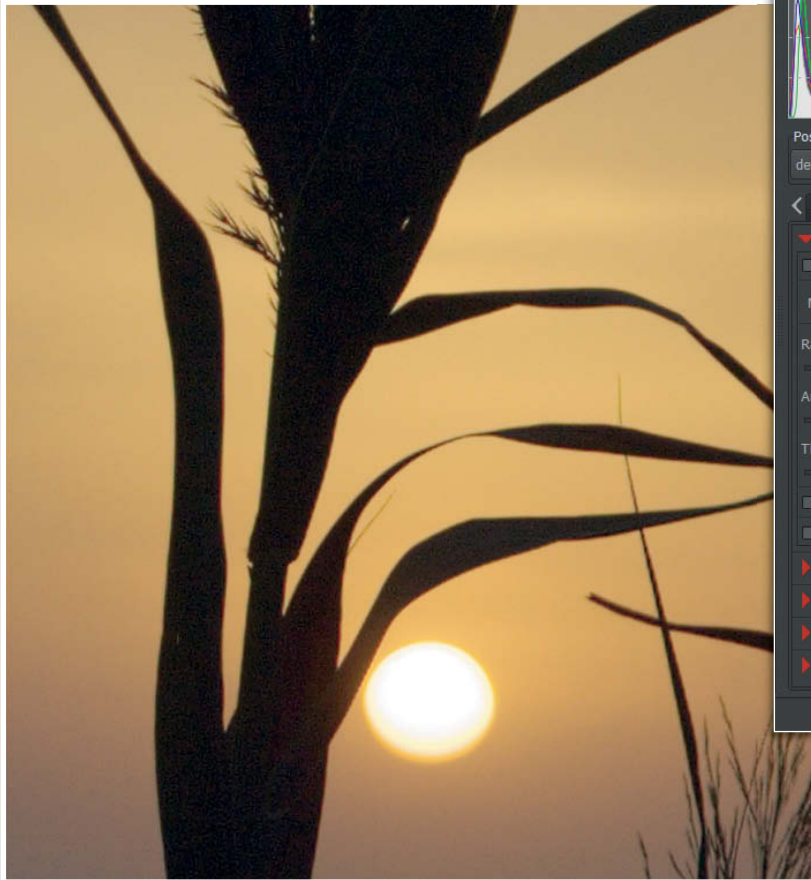
Even the sharpest image can benefit from additional output sharpening. It is nearly always possible to squeeze a little extra definition out of an outline.

type and amount of sharpening you apply will depend on the subject and the output medium you are using. Basically, the more discreet edges a subject has, the more it needs to be sharpened for ouput, and an image of a watch movement or a coin will require more intense sharpening than one of a baby. The most widely used type of sharpening filter is the Unsharp Mask type, which can be found in *RawTherapee* in the Detail tab.

Unsharp mask filters are based on an analog darkroom technique that combines a blurred (i.e, unsharp), inverted copy of the original image with the negative during development. The unsharp copy alters contrast at the edges of the subject making the dark side look darker and the lighter side look brighter, creating the illusion that the processed image is sharper than the original.

Digital unsharp masking works in exactly the same way, and the softer the copy, the larger the area that is sharpened in the result. An unsharp mask filter has three user-controllable parameters: Amount, Radius and Threshold.

As its name implies, the Amount setting determines the degree to which the contrast is increased, while the Radius setting alters the extent of the softening in the image copy and with it the size of the area that is sharpened at

the affected edges. With a digital filter, the softening of the image copy takes place invisibly in the background. The Threshold value determines the degree to which surrounding areas are protected from the effect you are applying. In other words, it determines how strong the contrast has to be before the filter takes effect. A value of zero means that the entire image is sharpened, while the maximum value of 16,384 (2^{14}) ensures that no sharpening occurs.

The Threshold setting is very important, and can be used to mask noise artifacts, skin pores and other similar details so that they don't get sharpened with the rest of the image.

If your image displays halo effects after sharpening, you have probably selected too high a Radius or Amount setting. However, images displayed at small sizes on a monitor or printed using an inkjet printer are usually quite forgiving of slight halos.

If you are processing a low-resolution image, you should stick to a Radius value of 1 pixel, but you can extend the setting to as many as 5 pixels for high-resolution images shot using a DSLR. The Amount slider covers a range of 0-1000, although 80-350 is a realistic range that can be used for most photos. If you need to use high Amount settings, you should

reduce the Radius setting accordingly. Threshold values of around 1000 are a good starting point for most images. The program lags every now and again, and you have to click in the open image to update the visible effect. Make sure you view images that you are sharpening at 100% magnification, or you will end up viewing the effect of the filter on the preview thumbnail, rather than the actual image.

The *Halo control* slider tends to produce more unsightly artifacts than reduced halo effects, and the *Sharpen only Edges* option doesn't produce any genuinely visible changes.

Conclusion

The steps described here are all you need to turn a well-exposed snapshot into a great photo. *RawTherapee 3* provides a free and highly effective entry into the world of RAW processing without forcing you to compromise on image quality. If you are experienced in production-line RAW processing, it is quite possible that you will give *Photoshop*, *GIMP* and others the cold shoulder once you have taken *RawTherapee* for a spin. (akr) **c't**

Maike Jarsetz

The Lightroom

Workflow

**Adobe Photoshop Lightroom is all about workflow.
The program's five modules – Library, Develop, Web, Print and
Slideshow – provide an intuitive base for all of your photo
management, editing and publishing needs. In addition to the
basic workflow and its wide-ranging cataloging functionality,
Lightroom also includes a whole host of high-end features that
simplify digital asset management and help you to achieve
better photographic results. This article uses a travelog to
show you around the workflow and gives you a selection of
useful tips on how to get the most out of this unique software.**

Overview

Lightroom combines all the basic components of a complete digital photo workflow in a user-friendly interface that is especially good for organizing large numbers of images. In addition to its basic tools, it offers a wide range of smart functions such as metadata presets, easily manipulable folders, flexible filters, a choice of output formats and non-destructive image editing.

Lightroom's modular structure determines the basic order in which you perform the major workflow steps, but its high degree of integration and flexibility mean that you can undo any steps you have taken at any stage in the process – the original image data remains untouched throughout. The program writes all the steps you perform to the catalog file and lets you call up and alter a file's metadata at any time. This means that you can, for example, alter a single processing step for a selected image in a Web gallery just before you upload it.

It is important to construct a workable folder system before you begin to import your images. If you are just starting out with *Lightroom*, you are sure to have your own folder structure already in place on your hard disk or removable media, which you will probably want to import as a unit. However, you can also specify a new location for existing or new images during the import process – the program then sorts new photos automatically according to the date they were taken. The Library module is designed primarily to help you select images and provides a wide range of different views to help you compare and study images in detail. There are also comprehensive rating and keywording tools to help you sort your images quickly and effectively. Selected images can then be saved to Collections that you can access at all stages of the workflow.

If you are processing large numbers of photos, as is often the case for travelogs or documentary projects, we recommend that you do so in a number of distinct stages, starting with global adjustmetns that you want to apply to all the photos in a sequence (in the Library module, for instance) followed by adjustments to selected groups of photos, and finally custom (often local) adjustments to individual images.

None of these phases ends by reinterpolating the image data, so you can adjust the results of each individual stage at any time during the process.

Catalog, Edit and Publish

Lightroom offers various output options, all of which are directly accessible from within the program's interface. It doesn't matter whether you want to publish a quick series on Facebook, create a new Web gallery, present a slideshow or make high-end prints of selected images – the high degree of integration within the program means that you can use a wide range of catalog data to enhance whichever type of output you choose to use. And you can still adjust development settings, even at this late stage.

Lightroom's catalog-based operation is also a great aid to image archiving. The program can seamlessly manage, filter and display large amounts of image data, regardless of whether it is stored on internal or external media, and reminds you of where you have stored things. Because the catalog file is so important, it is essential to save it and back it up at regular intervals, otherwise you run the risk of losing all the photo management and editing data you have so painstakingly collected and applied.

The simplest way to save your data is by saving the entire catalog, although you can save individual folders or collections too. You can decide whether you want to save just the catalog or your original images as well. Saving your preview images with the catalog increases the size of the catalog file, but significantly speeds up subsequent image viewing.

Important Settings for Large Catalogs:

Step 1

The Default Catalog:
If you are working with multiple catalogs, *Lightroom* automatically opens the last one you used at startup. You can switch catalogs at startup either by pressing the Alt key or by selecting the *Prompt me when starting Lightroom* option in the Default Catalog section of the General preferences tab.

```
  Load most recent catalog
✓ Prompt me when starting Lightroom

  /Users/maikejarsetz/Pictures/Lightroom/Lightroom 3 Catalog.lrcat
  Other...
```
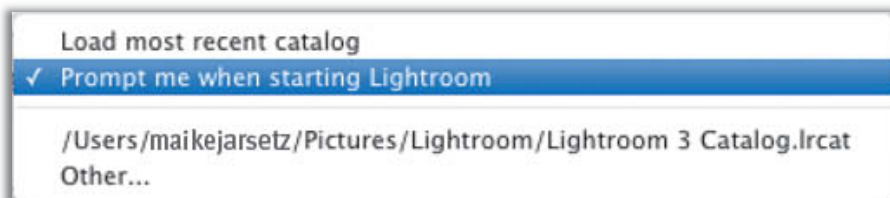
Backing Up the Catalog File:
Every time you quit *Lightroom*, the Back Up Catalog dialog requests user input. If you select the *Backup* option, the catalog (but not the image files) will be backed up. You can select a preset backup frequency in the General section of the Catalog Settings dialog. Selecting the *Never* option is a bad choice.

Step 2

```
  Never
  Once a month, when exiting Lightroom
✓ Once a week, when exiting Lightroom
  Once a day, when exiting Lightroom
  Every time Lightroom exits
  When Lightroom next exits
```

Step 3

JPEG or RAW:
Do you shoot JPEG and RAW versions of your photos? *Lightroom*'s default settings treat identical JPEG and RAW files as a single image and apply any adjustments you make to the RAW version. If you want to view and manage your JPEGs as separate images, select the appropriate option in the Import Options section of the General preferences tab.

```
☑ Treat JPEG files next to raw files as separate photos
```
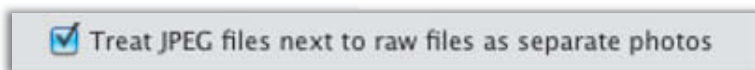
Step 4

Discarding Preview Images:
Lightroom saves full-screen preview images in a file called previews.lrdata, which speeds up the workflow by providing fast previews while you are working. However, this and other cache files take up a lot of disk space once you have finished working on your images. You can discard your 1:1 preview images at regular intervals to save space using the settings in the Preview Cache section of the File Handling tab in the Catalog Settings dialog.

```
  After One Day
  After One Week
✓ After 30 Days
  Never
```

Catalogs – The Center of the Lightroom Universe

Image management and editing is controlled by the *Lightroom* Catalog file, which contains various types of data that relate to each of the images in your collection. The program constantly accesses the catalog file while you are working and, as well as recording every change you make to an image or its metadata, saves the file's location, information regarding any collections it belongs to and output and publishing settings.

Creating Catalogs and Importing Images

The first step in setting up an imaging workflow is to import your existing photos into the *Lightroom* catalog. The import process leaves your images in their current locations and precisely mirrors your existing folder structure. Once a catalog file has been created, it keeps a watchful eye on the metadata of each image and faithfully records any changes without actually altering the original image data.

When you import new images, you can incorporate them into the existing catalog structure, which is shown on the right-hand side of the import window. By default, the import dialog opens automatically as soon as you insert a memory card into your computer's card reader. This function can be deactivated if you wish. The original images are copied from the memory card during import.

The Import dialog contains several automated features that are worth using if you want to save yourself effort administrating your library later. Select a destination folder within the existing structure and decide whether you want to save your images to a new, named folder or simply to the automatically generated date folder.

You can batch rename your files during import if you like, and there is a range of templates integrated into the program that you can customize to help you standardize your filenaming practices. You can also add copyright data, image descriptions and keywords to metadata presets that you can then apply globally during import. You can only apply one preset at a time, so make sure the data you select really does represent the lowest common denominator for all the photos you are importing.

Alternatively, you can import your photos in batches by checking or unchecking the preview thumbnails – either manually or by pressing the space bar for the currently selected image. The thumbnail view also incorporates a loupe view for viewing image details at various magnifications – simply double click an image to activate it.

Editing Metadata in the Library

Once you have imported your images into your chosen catalog structure, you can begin adding metadata and selecting images for further processing.

There are various ways to add keywords to your images. You can add individual keywords to a list or import lists of words, either in the form of a text file or from other *Lightroom* catalogs.

To add a keyword to the list, simply click next to one of the existing words and type. To simplify work with long keyword lists, you can also create sets of related keywords. The software even automatically generates keyword suggestions based on popular combinations of words related to ones you have already used. Clicking a keyword or keyword set toggles it on or off.

The Import dialog displays the existing catalog structure

The Compare view can be used to view alternatives next to your selected image

Comparing and Rating Images

One of the Library module's main tasks is to help you to rate your images and group them together in collections. There are four different views available for doing this. In addition to the Grid and Loupe views, which we have already looked at, you also have the choice of Survey and Compare views. Survey shows the currently selected image at maximum size in the preview window, while Compare lets you view alternative images side-by-side with the currently selected one.

Setting flags is a great way to make a broad initial selection, and you can add from one to five stars by pressing the appropriate number key. Pressing the 6-9 number keys adds a colored label to help you create sub-categories of photos.

Filtering Images and Creating Collections

All ratings that you apply to your images are stored in the catalog file the same way as any keywords you have added, and you can search them using Library Filters. You can show and hide the Filter Bar using the command in the View menu or using the Shift+backslash keystroke. You can then decide whether to filter your images according to metadata fields, attributes or a text entry. You can combine any or all of these search modes and you can also search for multiple metadata attributes.

Click on the lock icon at the right-hand end of the filter bar to lock the current set of search criteria for use with subsequent folders or collections. If you leave the lock open and switch folders, the Filter Bar will then be deactivated. You can save any combination of filter settings as a preset, which you can then apply to other views from the Filmstrip.

Click None to reset the Filter Bar, or switch it off temporarily using the Ctrl/Cmd+L keystroke.

You can repeat a filter search at any time, but it will eventually become more practical to sort your images into collections. To create a collection, select your image(s) and click the + symbol at the top of the Collections panel. If you wish, you can add the selected photos directly while naming your new collection. You can add more images or folders of images to a collection at any time using drag & drop. However, a collection is not a new folder and the images included in a collection are neither copied nor moved. It is, in fact, a kind of virtual folder, the contents of which are tracked by an additional entry in the metadata of each included photo.

This system allows you to include images in multiple collections without using extra disk space. If you want to adjust an image within a collection without affecting the original, you need to make a virtual copy of the image by selecting the *Make new virtual*

Tips & Tricks

Pressing the Shift key while you are rating images using the number keys automatically moves you on to the next image in the collection

Two typical Library filter searches used for narrowing down a selection

Quick Image Selection

Step 1
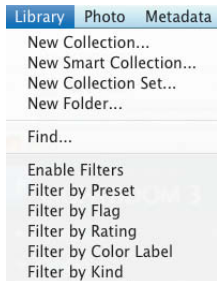
First, create a new collection with a meaningful name

Step 2
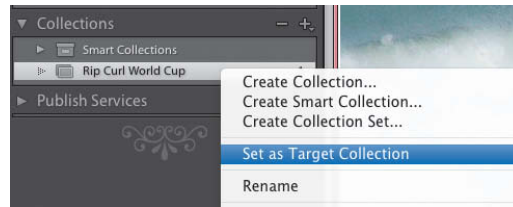
Right-click your new collection and select the *Set as Target Collection* option. The collection's name will then be marked with a + symbol.

Add to Target Collection "Rip Curl World Cup"

Step 3

Use the **B** key to add single or multiple images to your new collection

---

copies option while creating the collection. Virtual copies can also be created for the selected image(s) via the context menu or Photo menu, or using the Ctrl/Cmd+apostrophe keystroke. Virtual copies are denoted by a triangular icon in their bottom left-hand corner when viewed in the Library module or the Filmstrip, and you can search for them using Library filters. Once created, collections can be accessed from all other *Lightroom* modules.

Smart collections are a special case and use filter criteria selected during the collection creation process to define the collection. You

can use a smart collection, for example, to help you to quickly and easily find all the photos that were shot using a particular lens or have a particular rating. You can even create temporary collections by combining criteria such as five rating stars with a last editing date of today. The next day, the smart collection will simply no longer exist.

At this stage, you can also use the Metadata panel to add various types of titles or captions to individual images.

What all of these selection tools have in common is that they help you to single out images for further processing.

Tips & Tricks

If you want to give multiple images identical descriptions, select them using a Ctrl/Cmd click and move the switch on the Sync button to Auto Sync. Any changes you make to metadata will now be applied to all the currently selected images.

Multi-phase Development

You can begin to develop your images during import by applying system or custom develop presets.

However, you should consider carefully what types of develop presets you really want to apply. At this early stage, it is better to stick to simple, global adjustments, such as the application of a particular camera profile or basic color balance settings. As with all other *Lightroom* adjustments, changes that you apply during import can be undone or fine-tuned later.

Library-level Pre-development

Although the Library module is generally weighted toward selecting and organizing your images, you can make rating your images easier by making some basic changes in the Library. For example, you can equalize exposure for all the photos in a sequence. The Develop Settings sub-menu in the Library's Photo menu contains the Match Total Exposures command, which adjusts the exposure of all the selected images to match that of a reference image. You can see which changes this makes in the Develop module's exposure settings.

The Library module has its own Quick Develop panel that contains a wide range of adjustments. These are not as sophisticated as those built into the Develop module, but nevertheless give you a broad spectrum of possibilities for adjusting the look of your photos.

The major difference between the two types of adjustment is that Quick Develop settings can only be adjusted up or down in predetermined increments, whereas the Develop model lets you enter precise numerical values. For example, the Exposure setting in the Library module uses ⅓ or whole f-stop increments that are analogous to those used in most cameras' settings dials. Most Quick Develop settings can only be judged visually, although you can fine-tune them in the Develop module and read descriptions of what actually happened in the History panel.

In general, you should only use Quick Develop adjustments to help you sort and rate your images. Once you have decided which images you want to process, use the Develop module to apply any additional changes.
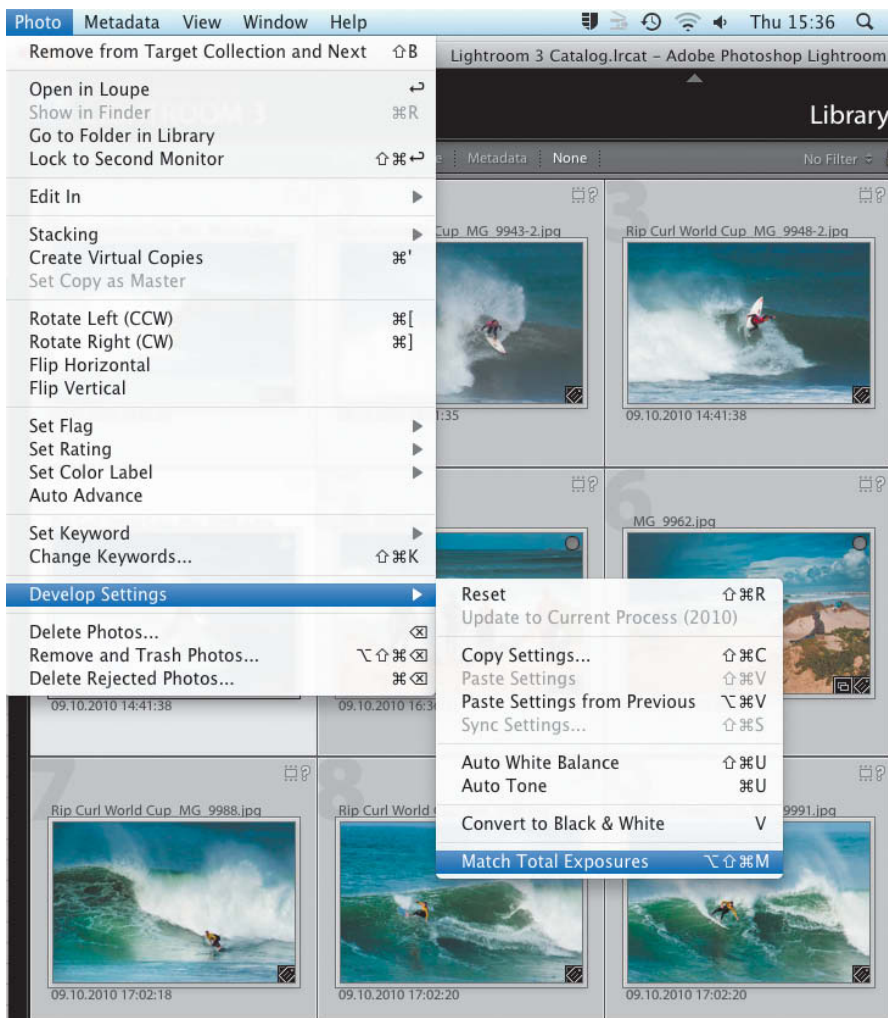
The Match Total Exposures command can be used to match the exposure of selected images to that of a single reference image

The settings in the Quick Develop panel are basically the same as those included in the Develop module, but are easier to apply and not quite as precise
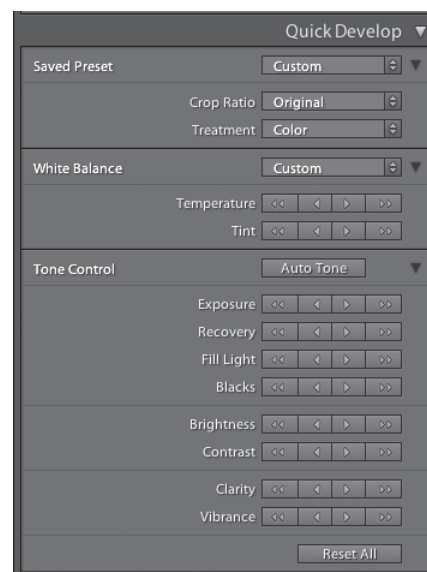
Creating and Saving Develop Presets

First off:
Make sure that your reference image hasn't been adjusted. This ensures that your preset only contains the effects that you now select. Click reset if you are not sure if this is the case.

Step 1
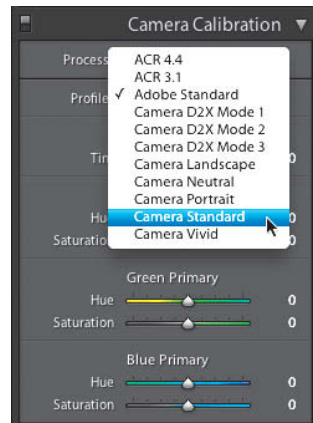
Step 2

Set a base camera profile:
Open the Camera Calibration panel and select one of the preset profiles. Camera Standard, for example, represents a default in-camera JPEG treatment.

Step 3

Process your reference image:
Apply the adjustments that you want to apply to all of your images – for example, basic contrast enhancement using the Clarity slider and the Tone Curve, or color adjustment using the Camera Calibration and HSL tools.
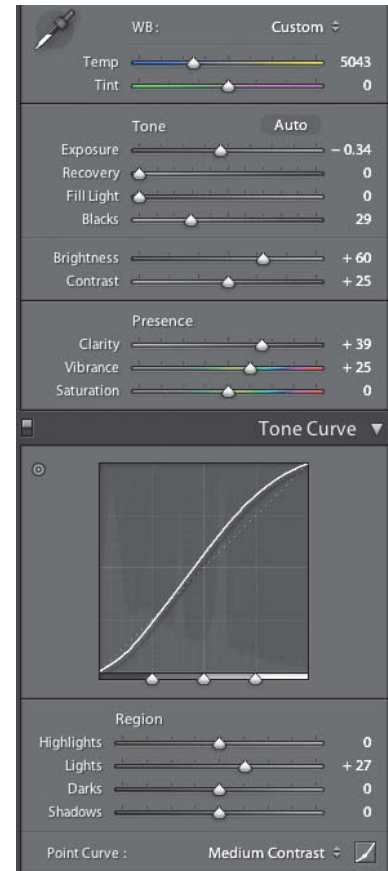
Step 4

Create a new Develop preset:
Click the + symbol at the top right of the Presets panel and use the check boxes to determine which adjustments you want to save. Deactivate the *Exposure* option if you want to keep control of the exposure values for each image individually. Don't activate any options that haven't been adjusted in the reference image.
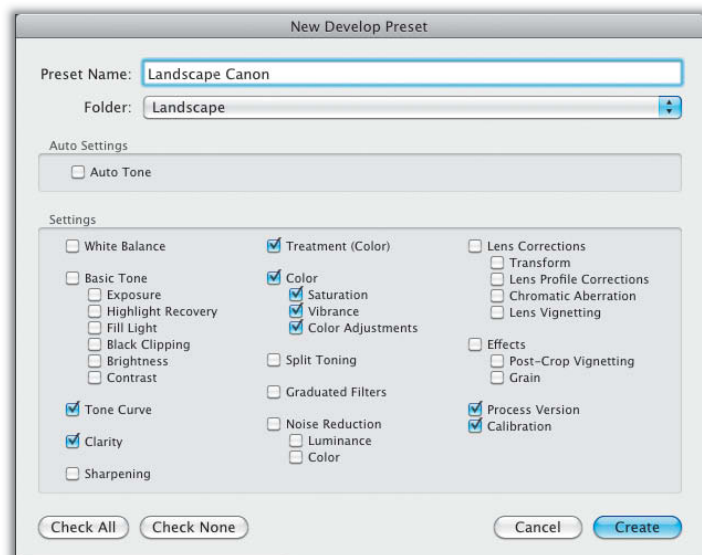
Step 5

Apply your preset:
Select your preset from the Develop Settings list in the Apply During Import panel in the import dialog to apply it automatically to all imported images, or use it on individual images from within the Develop module

High-end Develop Steps

Once you have selected your images and made any initial adjustments, it is time to switch to the Develop module and make global changes to either the entire sequence or selected batches of images. You can, of course, pre-develop individual images and synchronize the changes you make with the rest of your photos later, although applying a specific change to all images at once makes it easier to judge its overall effect.

Once you have selected the images you want to synchronize using Click+Shift, you can use the virtual switch built into the Sync button to switch to Auto Sync.

Local adjustments can be applied using the tools in the tool strip

Typical global adjustments include white balance, exposure, local or global contrast, saturation, shadow/highlight tuning and changes to tonal values.

You can check the effects of your changes using the Before/After view, which is activated using the **Y|Y** button in the toolbar. Auto Sync can be deactivated at any time if you want to apply a change to an individual image.

You can apply develop settings you have made to other images. To do this, deactivate Auto Sync, select the images you want to adjust and leave your reference image active. Click the Sync button and select which parameters or group(s) of parameters you want to apply.

Fine-tuning

Once you are done with your global adjustments, you can fine-tune individual images – for example, by cropping them or applying local adjustments. The major fine-tuning tools are located in the Develop module's tool strip, and include Crop Overlay, Spot Removal, Red Eye Correction, Graduated Filter and the Adjustment Brush. Clicking a tool opens the corresponding settings panel. The Graduated Filter tool and the Adjustment Brush include a range of settings that can be applied locally by dragging the cursor within the image frame.

The most interesting aspect of local adjustments is the degree of flexibility with which they can be subsequently altered. You can apply an effect partially by adjusting the Flow or Density brush settings, and the overall strength of the effect can be changed without adjusting the relative strengths of the other parameters using the Amount setting.

The more changes you make to an image, the larger the file's metadata entry in the catalog will become. This means that you can undo and change adjustments you have made even after you have closed and restarted the program.

The Snapshot panel lets you save and recall any image state during the development process, and you can compare specific History steps with saved snapshots using the Compare view. Because individual states and development steps are saved as complete metadata sets, you can also synchronize other images with them later should you decide that a previous state was better than a subsequent result.

Tips & Tricks

The Shift+Y keystroke switches to the Before/After view, and clicking either of the images takes you directly to a 1:1 view to help you assess the differences between the two versions

Making Global Adjustments to Your Images

Step 1
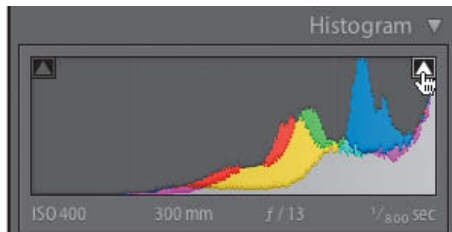
Keep an eye on the histogram:
The histogram at the top right-hand corner of the program window is shown by default but can be hidden using the Ctrl/Cmd+0 keystroke. The histogram helps you to assess the tonal range of an image and to determine whether clipping has occurred at the shadow and highlight ends of the tonal scale. Clicking the triangular icons in the upper corners of the histogram window activates the clipping warnings and highlights critical areas in the preview image in red (highlights) or blue (shadows).

Adjusting the exposure range:
The Exposure and Blacks sliders can be used to adjust overall exposure. They directly influence highlight and shadow detail, so keep the clipping warnings active when you are using them. Warnings can also be displayed temporarily by pressing the Alt key while you adjust the sliders.

Step 2

Brightness, highlights and shadows:
As an alternative to overall exposure adjustment, the Brightness slider can be used to adjust just the midtones. This compensates for a degree of underexposure while avoiding the risk of burning out previously optimized highlights.
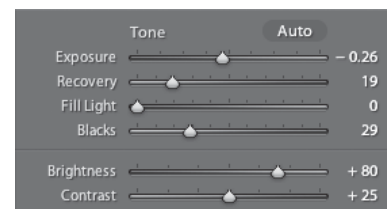
Step 3
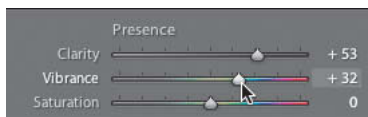
Vibrance and Clarity:
These two sliders definitely belong to the fine-tuning department. Vibrance is a kind of advanced saturation adjustment that minimizes clipping as colors approach full saturation by adjusting less-saturated colors more than more highly saturated ones. The Clarity slider adjusts local contrast to add depth to an image, producing crisp details without the use of tone curves or sharpening tools.

Step 4

Contrast and Tone Curve:
Tone curves allow you to adjust contrast selectively for the details that need it most. Always use tone curves in preference to conventional contrast adjustment sliders if you want to keep full control of the adjustments you make. Beginners often prefer to use the parametric version of the curve with its dedicated sliders, as this helps to avoid making excessive adjustments that spoil overall color distribution. Experienced users and *Photoshop* pros prefer to use point curves and set their own control points. The button at the bottom right-hand corner of the panel switches between the two curve types.
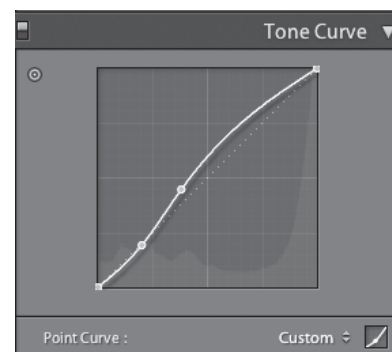
Step 5
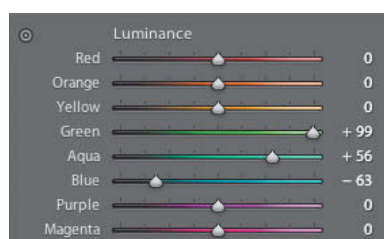
Adjusting colors using the HSL panel:
The HSL (Hue, Saturation, Luminance) tools are, strictly speaking, targeted adjustments, but nevertheless provide a great way to influence the character of a photo's colors. Polarized-looking skies can be selectively applied and skin tones slightly desaturated by adjusting the brightness and saturation of carefully selected tones.

Exporting Your Images

Digital photos are made for sharing – preferably as soon as they have been processed. Whether you want to upload them to Facebook or another social network, share them on Flickr or simply have them printed using an online service, *Lightroom* has all the necessary functions built in, and also includes tools for adjusting the size of your images or tweaking metadata during the export process. The following sections detail some examples of the available export options.

Exporting for Print

If you want to have your images printed using an online service, you should adjust them to the right size before you upload them. *Lightroom*'s non-destructive editing system doesn't change a photo's resolution, but can change the aspect ratio of an image so that you don't run the risk of having your images randomly cropped to fit a print provider's preset paper size.

The simplest solution is to create virtual copies of your images for each separate format and then use the Crop Ratio tool in the Quick
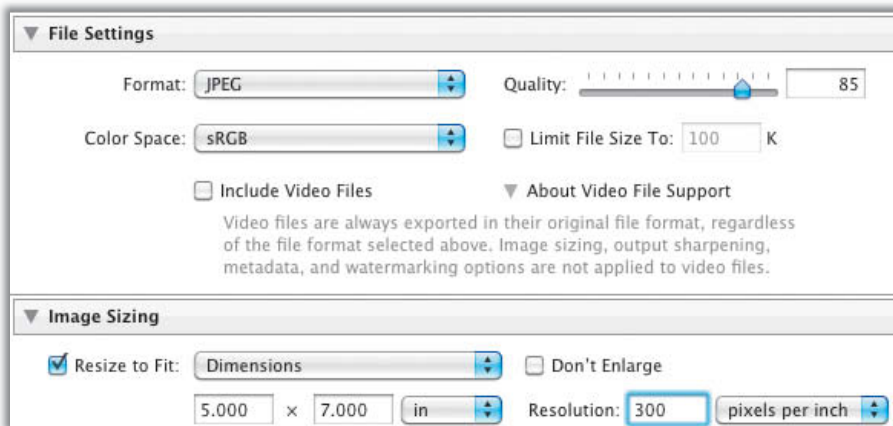
Part of the comprehensive export dialog, showing the sRGB color space setting that you should always use if you are ordering prints online

Develop panel to select your desired format – and all this is possible without even leaving the Library module!

The Enter Custom command in the tool's pop-up menu can be used to define your own format, but always places the result in the center of the frame. If you want to make completely customized crops, you will need to switch to the Crop & Straighten tool in the Develop module.

Pressing the R key in the Library view switches automatically to the Crop & Straighten tool in the Develop module. Pressing the G key reverses the switch.

Once you have prepared your crops, select the images you want to output and open the Export dialog. Here, it is important to select the correct image size in order to avoid exporting unnecessarily large amounts of data. The program includes a large variety of sizing options that cover just about every conceivable application.

The *Dimensions* option allows you to scale the proportions of your images at will, whereas the *Width & Height* option preserves the given aspect ratio, enlarged or reduced to fit the dimensions you enter. If you have already selected a fixed aspect ratio using the Crop tool, you can scale it by entering a specific value for the *Long Edge* or the *Short Edge* option. The Image Sizing section of the Export dialog is the only place within *Lightroom* where you can enter precise size and resolution values.

If they aren't already saved in the sRGB color space, remember to convert your images before sending them to an online print service. sRGB is the industry standard, and only a very few online print services support other color spaces. Along with the JPEG compression setting, the Color Space setting is part of the File Settings section of the Export dialog.

Preparing Images for E-mail Delivery

The Export dialog contains a system preset for images that you want to send via e-mail. Once you have selected your export settings, navigate to the *Open in Other Application* option in the Post-Processing section at the bottom of the dialog window and select your mail application from the drop-down menu that appears. This automatically attaches your exported images to an e-mail. As with just about every other set of *Lightroom* settings, these too can be saved as a preset for later use.

Exporting to Facebook and other Social Networks

Since the release of version 3, *Lightroom* has supported direct upload to Facebook and Flickr, and allows you to add images to existing online albums or create new ones. In summer 2011, Adobe also released a plug-in that enables direct upload to photoshop.com. Once installed, the plug-in is available via the Publish Services panel in the Library Module.

To set up a Facebook export, click the Facebook Set Up button in the Publish Services panel, confirm that you are familiar

Tips & Tricks

Metadata entries are a fantastic way to manage copyright information and image captions, but often contain other information that you won't necessarily want to make public, such as the exposure values used to take a photo or the RAW development steps you used. For such cases, the Export dialog includes the *Minimize Embedded Metadata* option that reduces the information exported with your file to cover just the relevant copyright data fields.

with the Facebook terms of service and enter your Facebook login details. Once you have been authorized, you will be linked directly to your account through the *Lightroom* interface.

The settings options available for upload to Facebook are the same as those built into the Export dialog.

Uploading images to an online service is similar to creating a collection, in that the images you upload are all located in one place and are processed to the same degree.

When you log on to Facebook, *Lightroom* automatically checks whether images that you have already published have been altered and lists them as New Photos to Publish if appropriate

Presenting Your Photos

Lightroom offers various ways to output and share your images, although some of the more useful options are not that easy to find. For example, there is no obvious way to give individual images captions from within the Slideshow or Web modules. Once again, image metadata is the answer, and various metadata entries can be set as captions and titles for your images.

If you want to publish your images in a Web gallery, there are other details you have to consider. For example, if you are publishing large images, you should protect them against unauthorized use with watermarks. The *Lightroom* watermark editor includes a wide range of settings for customizing the location and text attributes you use.

All of the *Lightroom* output modules are based on selections that you make in the Library view and save as collections. The starting point for most Web galleries and slideshows is one of the templates provided with the program. Once you have selected your basic Web gallery layout, you can fine-tune it to your own requirements using the options in the Layout Style and Color Palette panels before adding titles, captions and shadows.

Features and Limitations of the Slideshow Module

Slideshows are child's play to create in *Lightroom*. Select your images in the Filmstrip or using a collection and select a template from the Template Browser panel. You can then fine-tune image positioning and image shadows/borders using the Options and Layout panels. You can also select background colors and gradients or a custom background image. The Overlays panel provides options for adding metadata entries, text and
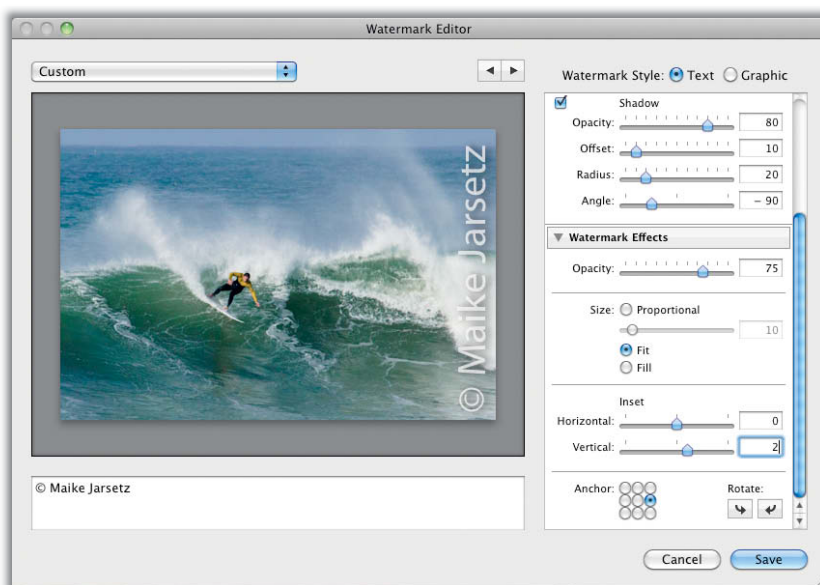
The *Lightroom* watermark editor offers a wide range of custom settings

watermarks. Individual captions can be added via a photo's metadata - see the box opposite for more details on how. You can also enhance your presentation with custom intro and ending screens and an audio soundtrack that you can set up to fit the length of the show. Currently, there is no option for using multiple music files as a soundtrack.

If the on-board options are sufficient for your needs, you can play your slideshow directly from within the *Lightroom* interface. The *Prepare Previews in Advance* option prevents your slideshow from juddering, especially if it comprises large amounts of data. If you prefer to use dedicated AV software to prepare your presentation, you can export your processed files as JPEGs to your chosen application. You can save your finished slideshow either as a video file or a

PDF in various sizes and at various resolutions.

By default, the Slideshow module saves slideshows at a size and aspect ratio that match the monitor currently in use, so you need to make sure you enter the correct formats for your intended playback device. If you don't, you might end up unintentionally cropping parts of your carefully prepared images.

Secure Web Galleries

The Web Gallery layout options are just as user-friendly and intuitive as those found in the slideshow module. The styles provided include not only default HTML and Flash options, but also three Airtight Interactive gallery layouts. Additional information, such as the site's title, description or contact details is simple to enter in the appropriate boxes and is automatically linked when the gallery is published.

To keep your published images secure, you can use the program's built-in watermark editor to copyright your images. This offers a wide range of text, graphics and transparency options as well as flexible positioning and scaling of the finished watermark.

You can upload your finished gallery to your web server directly from the *Lightroom* interface and the upload settings for the SimpleViewer allow you to deactivate the *Allow right-click to open photos* option to prevent people from downloading your full-size images once they are up on the Web.   (pen)

Image export is always based on a selection made in the Filmstrip. You can decide whether you want to export all the photos in the Filmstrip or just the selected or flagged ones.

Adding Captions

Image metadata also offers plenty of space for saving titles and captions, which can then be used as custom image descriptions at the image export stage. This how-to describes how to add captions to a slideshow.

Step 1

Create a collection or make a selection in the Filmstrip and then switch to the Slideshow module. Use the options in the Layout panel to set up your slideshow.

Step 2

Click the ABC button in the slideshow toolbar to create a new text entry and select Edit in the pop-up menu that follows. You can now use the Text Template Editor to select which Exif, IPTC or other file attribute to set as your caption.

Step 3

You can add any missing metadata by switching to the Metadata panel in the Library module and entering it there. Each image in your slideshow will now have its own custom text overlay.
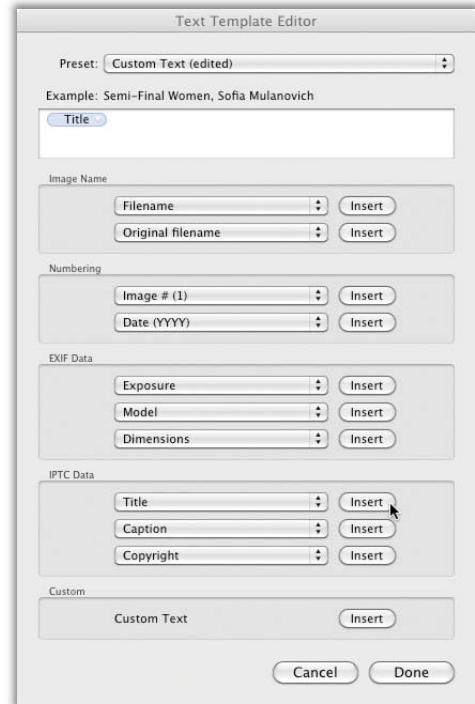
Coming up in Issue 8 ...

Interior Photography

Interiors present the photographer with a complex set of challenges. The room itself, the fittings and furnishings and the light all have to be perfectly coordinated and captured. In this comprehensive workshop, architectural photographer Adrian Schulz explains how to select the right subject, arrange your fixtures and props and compose your image. He also gives tips on mastering a variety of different lighting situations.

Smoke, Steam and Fog Effects

Whether you want to capture a smoking gun, a subtle plume of steam from a cup of coffee or a wall of fog for a rock band photo shoot, our hands-on special introduces you to the often surprisingly simple techniques involved in creating, capturing and processing effective smoke and fog effects. The author uses real-world examples to demonstrate how to set up and capture striking images and gives you tips to help you put your own ideas into practice.

Color Management

If you want to shoot genuinely reproducible colors you have to apply consistent color management techniques to all stages of the image creation process, from capture to final output. Our workshop explains how to calibrate your camera and monitor, as well as how to make the appropriate settings for all of your devices and set up your workflow so that the colors you end up with are the same as the ones you originally saw through the viewfinder.