Computational cameras perfect your photos for you

17 November 2009 by Jim Giles

Many of the new techniques tackle the old problem of capturing a fleeting moment. Imagine watching a kingfisher arrowing towards a lake surface. It takes a lot of patience, skill - and luck - to capture the precise moment at which the bird breaks the water's surface. Using an everyday digital camera, it is possible to switch to recording video at an instant, but then to have to look through hundreds of frames to find the precise moment. Computational cameras can do this automatically by solving three-dimensional optical flow, a physics-based technique which follows the movement of each pixel in a series of stills from the frames captured in the half-second or so before the shutter was pressed, hopefully capturing that crucial moment.

Hints of the changes to come can be found in cameras such as Casio's EX-F1, which launched last year and has been dubbed the first computational camera. In poor light, photographers face a difficult choice: use a flash, which can produce a harsh illumination, or go for a long exposure, where the risk of image blur increases. The EX-F1 offers a third option. It shoots a burst of images at long exposures and its computer merges the shots into a single image, reducing the blur as it does so. The process may not yet outperform established anti-blur techniques, but its existence is a significant advance in computational photography at an imaging technology conference in Monterey, California, this week. Low-cost processing and memory combined with new digital sensors will deliver richer images created by fusing elements from multiple shots and even video.

Cohen's software is computer-based at the moment, but he says it could be embedded in our cellphones to gigabytes of images stored on hard drives. But if you thought the revolution finished with the death of chemical film, think again. Computational photography promises equally dramatic changes, turning even the most ham-fisted of snappers into veritable Cartier-Bressons.

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Tricked into taking a good picture (Image: Ankit Mohan/Douglas Lamman/Shinsaku Hiura/Ramesh Raskar)

In labs around the world, researchers are developing a slew of other computational tricks for cameras. "We're creating images that people have never been able to produce," says Marc Levoy at Stanford University in California.

A computational camera would provide a new 'point of view' in which the software not only captures multiple frames but also includes a computational model of the real world and its parameters such as the location of the sun, weather conditions, objects in the scene, and so on. The new technology is the latest in a string of advances that has transformed photography - from the invention of the digital camera to the rise of computational photography.

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But by moving the sensor and lens at just the right relative speed, Raskar is able to select a vertical plane in the image in which focus is preserved. He says he is now talking to camera and cellphone manufacturers about licensing the technology.

Another feature cameras might one day include is panorama software, which could create 360-degree cylindrical panoramas by stitching together a series of shots, adjusting for slight tilts. A technique known as “all-focus imaging” could be used to create high-resolution close-ups in which, unlike current macro photographs, all of the image is in focus. The technique involves taking a series of macro images in which different layers of the scene are in focus, and then merging them to create a single image. Aseem Agarwala, senior research scientist at Adobe Systems in Seattle, has already developed an all-focus algorithm that has been incorporated into Adobe’s image-editing package Photoshop.

Alternatively, when half of a scene is in shadow, a camera could automatically take two shots at different exposures and merge them to create an image in which all parts of the scene appear well lit.

“The distinction between a cellphone and a computer has already gone,” says Cohen. “Now the distinction between a camera and a computer is going away.”

As has happened with cellphones, the distinction between a camera and a computer is going away.

If there is a note of caution, it comes from camera manufacturers. Many digital cameras already come with basic computational features, such as the ability to lighten areas of the shot that are in shade, and it is not yet clear, at least to the manufacturers, what extra functions users want.

Voice Control
Thu Nov 12 01:19:12 GMT 2009 by Graham
http://www.theaxion.com

I have been taking photographs for over 45 years as I started when I was 10 with a camera I bought from Woolworths and then one that my uncle gave me. From the very start I began to process the images in chemical baths and I built a photographic enlarger out of an old cheese snack tin and various cannibalised bits of cameras and lenses. I was as much facinated by the technology of photography as the art.

How things have progressed, now I do everything digitally and produce some stunning images without the hazard of dangerous chemicals and living a vampire like existence in darkened rooms.
However, the digital age brings with it so many options, switches, menus, and settings on today's cameras that it can take many minutes to get the camera in a state to take a decent picture. Often a setting is not right and then it has to be "fixed" in the Photoshop software on the computer and in some ways, as a traditionalist who believes in the magic and art of the photographer capturing the moment of light, I feel that I am cheating by doing this.

A solution for me would be, partly as described in the article, some intelligence in the camera but also a way to avoid having to check switches, menus and alter settings. Therefore I feel that the next generation of cameras should be voice controlled.

I would like to tell my camera what kind of picture I want to take, for example, out of the corner of my eye I see a fast moving bird of prey about to attack its next meal and as I turn towards the event I could say to the camera "bird, fast" and this would make all the settings required to increase shutter speed, focus adaptation for an object moving towards me, and expose for the bird and not the sky whilst keeping the background out of focus. It would be nice if it locked on and zoomed into the bird as well.

Similarly if I happen to see a UFO (ever), my camera should be able to get it right by just me saying to it "UFO". So perhaps we will finally have a UFO image that people can see clearly and believe in rather than blobs and streaks of out of focus coloured lights. That is assuming I along with my camera are not abducted.
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James Banfield, a spokesman for Nikon UK, says that his firm will listen to consumers and add more features if the demand is there. But he points out that the features need to be robust and easy to understand. Some aspects of camera interfaces are already complex, Banfield says, so manufacturers have to think hard before adding further features.

That caution has prompted Levoy to develop his own computational camera. Compared with commercial devices, Levoy describes his "Frankencamera" as "ugly, big and heavy". But it is portable and battery-powered, so researchers can take it out of the lab and experiment with it. The device includes a Canon lens, a light sensor from a Nokia mobile and runs the Linux operating system. All of its functions, including metering, focusing, demosaicing, de-noising and white balancing, can be controlled using the camera's open-source software, which will be released next year.

Levoy is applying for funding so that he can produce a number of the devices and give them to other research groups. Once the device is out there, the list of computational tricks could get even longer. "People will surprise us by coming up with stuff we haven't even thought about," says Levoy.

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Teams of modern-day birdmen are racing to pull off a stunt they hope will be groundbreaking – but only metaphorically

Innovation: The dizzying ambition of Wolfram Alpha
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**Poor Substitutes**

Tue Nov 17 11:40:08 GMT 2009 by Daniel

The "bokeh" simulation doesn't look like the real thing. It looks like motion blur applied to selected parts of the picture in Photoshop.

I hope we don't start replacing real photography effects with cheap lookalike simulations.

**Poor Substitutes**

Tue Nov 17 12:14:33 GMT 2009 by Richard

It's only a proof of concept, I think we can expect some improvements. If you cannot tell the difference, what is a 'real' effect and what is not.
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