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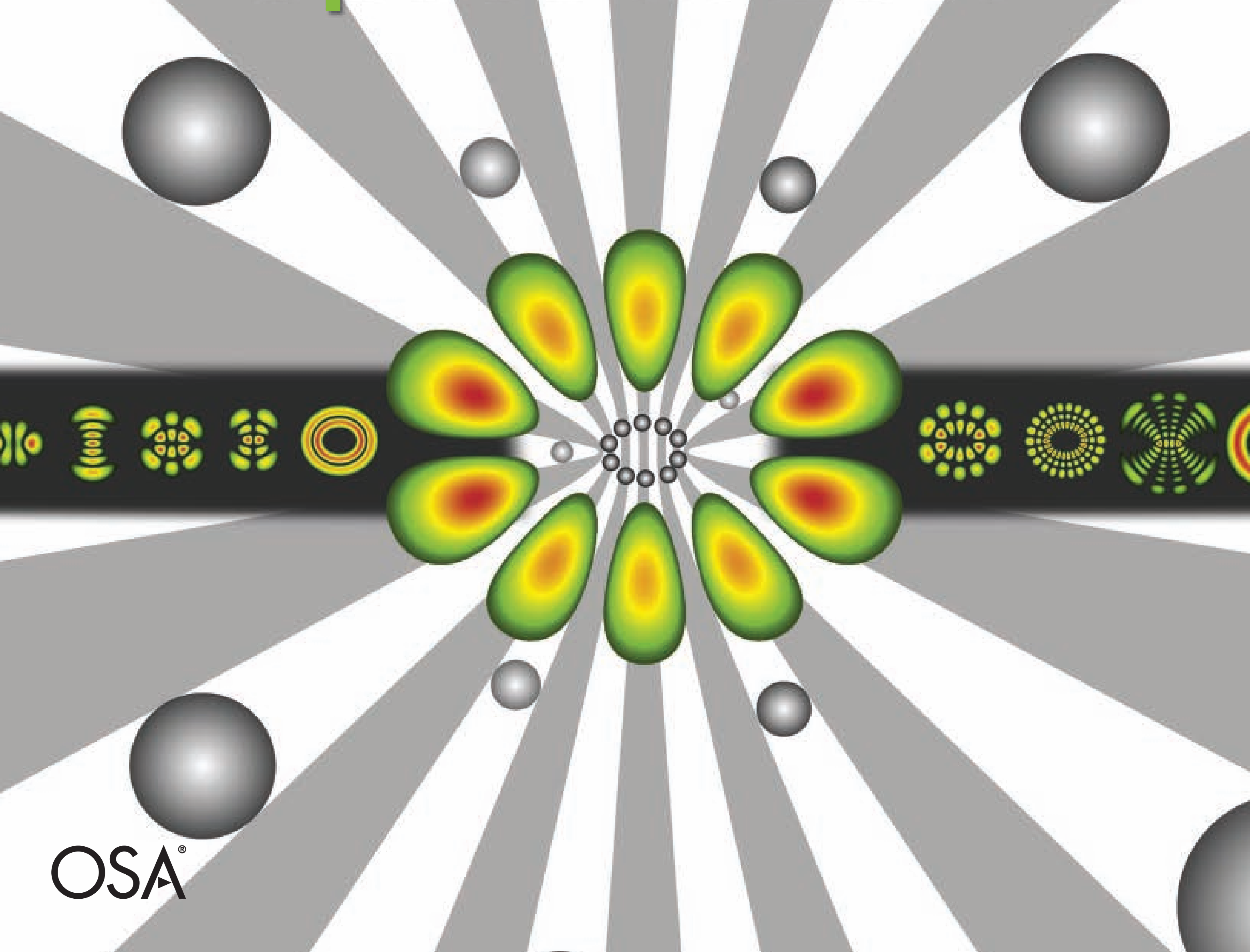
Optics in 2011



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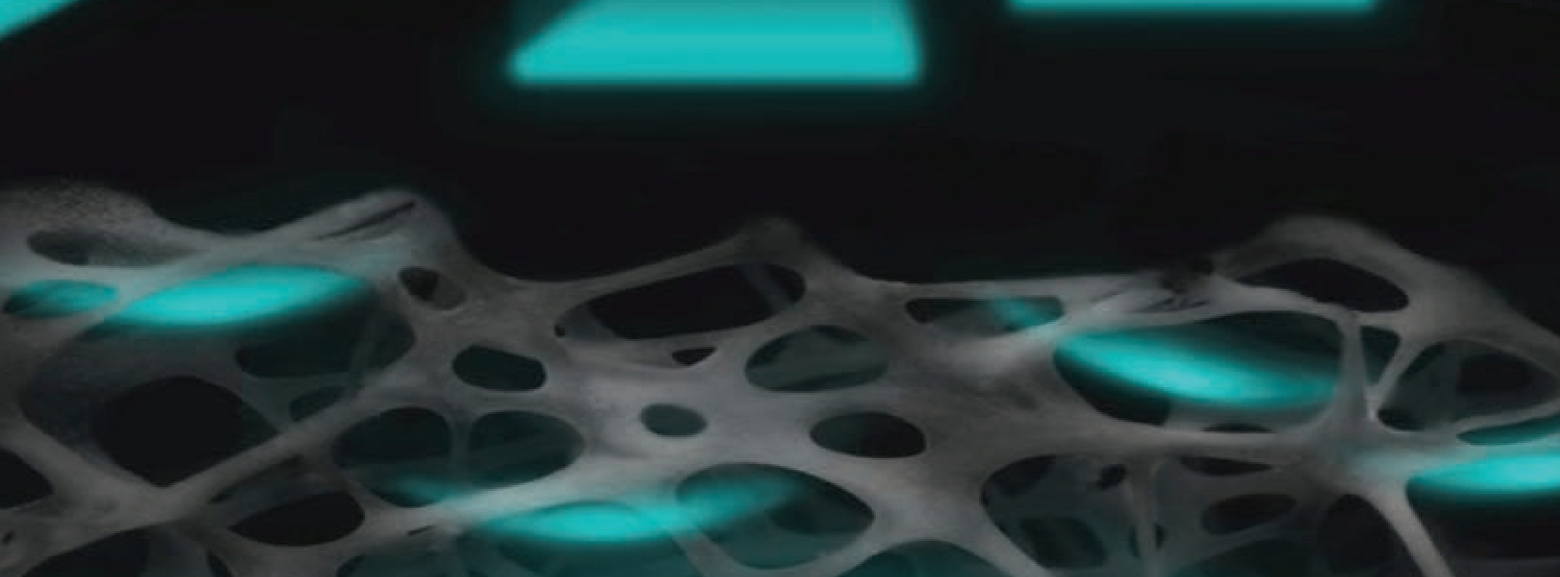
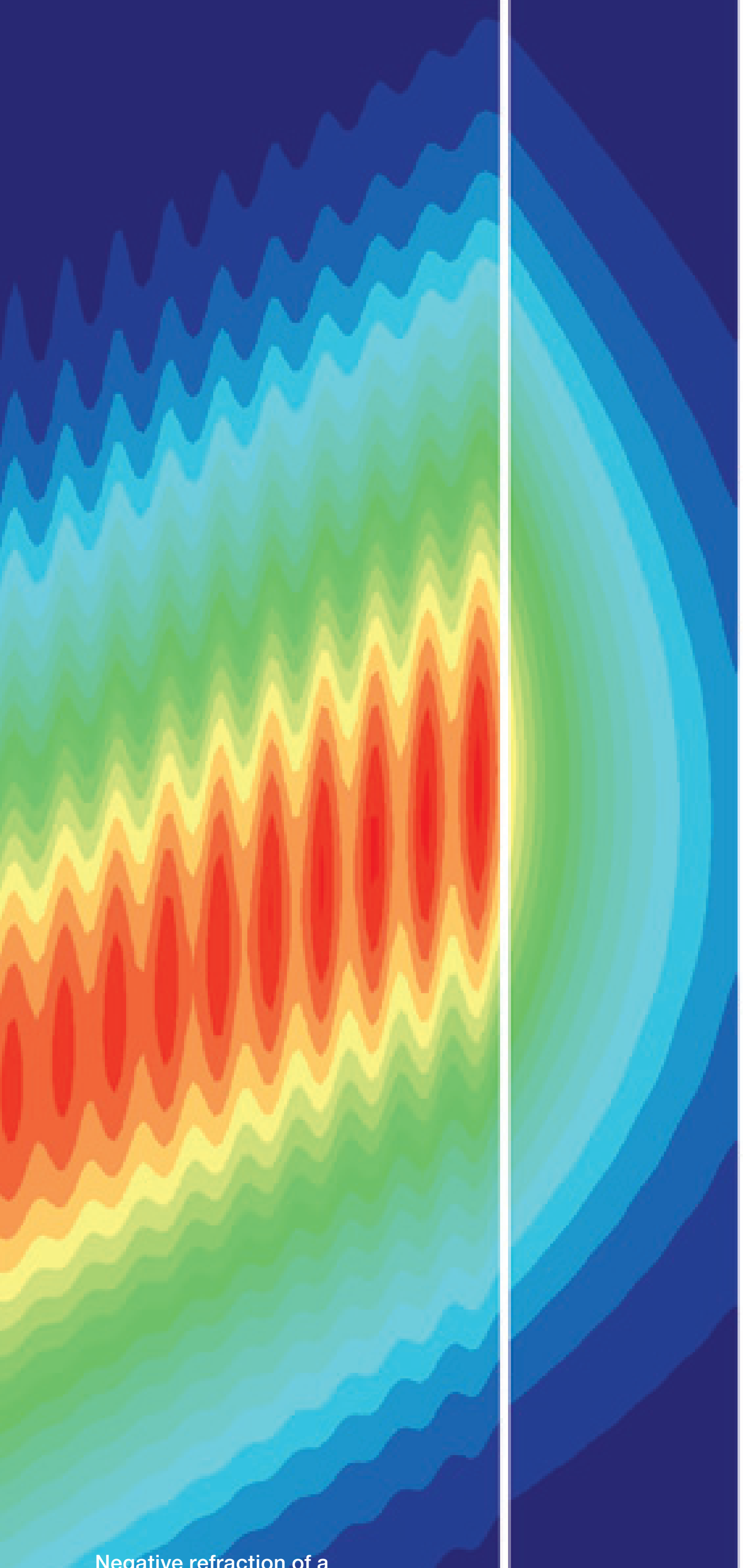


Optics in 2011

COVER: The organization of particles in tailored light fields. Illustration by C. Alpmann, Institute for Applied Physics, University of Muenster, Germany. (See Alpmann et al. p. 28.) This page: Artist's impression of a wavefront-shaped ultrashort pulse focused in space and time through a thick bone sample. (See Katz et al., p. 45.)



Negative refraction of a far infrared beam passing through crystal quartz. (See Dumelow et al. on p. 42.)

Optics in 2011

PANEL CHAIR: Robert D. Guenther, Duke University, U.S.A.

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This special issue of *Optics & Photonics News* (OPN) highlights the most exciting peer-reviewed optics research to have emerged over the past 12 months. The areas covered in 2011 include bio-optics, detection, diffraction, imaging, interferometry, nonlinear optics, photonic structures, plasmonics, quantum optics, terahertz technology, transformation optics, ultrafast optics and 3-D recording and display.

This year's issue includes 30 summaries representing the work of more than 150 authors from 15 countries. Submissions were judged on the basis of the following criteria:

- The accomplishments described must have been published in a refereed journal in the year prior to publication in OPN.
- The work should be illustrated in a clear, concise manner that is readily accessible to the at-large optics community.
- The authors should describe the topical area as a whole and then discuss the importance of their work in that context.

As we did last year, OPN has incorporated multimedia elements into our December issue. We are pleased to offer 15 summaries that are accompanied by videos. You can access them through our December digital edition, available at www.opnmagazine-digital.com/opn/201112, or through our main website, at www.osa-opn.org.

We plan to continue adding multimedia to our summaries from now on, and we'd love to hear your suggestions for how to improve our digital offerings. Please email opn@osa.org with your feedback, or send us research summaries with multimedia that we can use to experiment for next year.

OPN and OSA would like to thank all the researchers from around the world who submitted summaries, as well as our panel chair and guest editors.

ONLINE EXTRA: Visit www.osa-opn.org to watch a video highlighting the Optics in 2011 research findings.

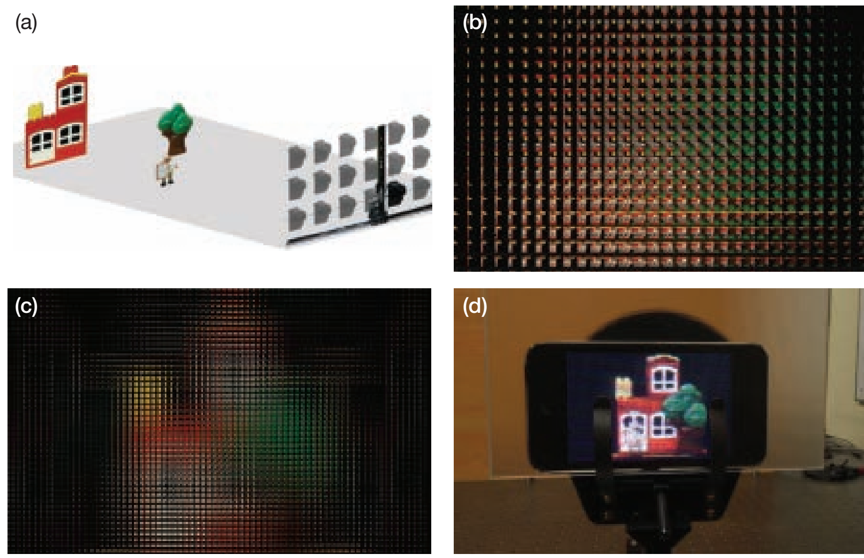
Full Parallax 3-D TV with Programmable Display Parameters

Manuel Martínez-Corral, Héctor Navarro, Raúl Martínez-Cuenca, Genaro Saavedra and Bahram Javidi

Stereoscopic or auto-stereoscopic television monitors usually produce visual fatigue among viewers due to the convergence-accommodation conflict. An attractive alternative to these techniques is the so-called integral photography approach (also known as integral imaging, or InI) that was proposed by Lippmann in 1908[1]–the notion that one can record in a 2-D matrix sensor many elemental images of a 3-D scene, each of which stores information from a different perspective. When this information is projected onto a display device placed in front of an array of micro lenses, any pixel generates a conical ray-bundle. The intersection of these bundles produces the local concentration of light density that permits the 3-D reconstruction of the scene—without special goggles, with full parallax and without visual fatigue.[2]

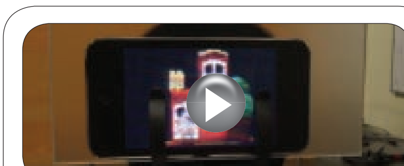
The Lippmann concept was resurrected about two decades ago due to the fast development of optoelectronic image sensors and displays. One important challenge of the approach is figuring out how to address the structural differences between the capture setup and the display monitor. To tackle this, we developed an algorithm, called the smart pseudoscopic-to-orthoscopic conversion (SPOC), which permits the calculation of new sets of synthetic integral images that are fully adapted to the display monitor characteristics. Specifically, this global pixel-mapping algorithm permits one to select the display parameters such as the pitch, focal length and size of the microlens array (MLA), the depth position and size of the reconstructed images, and even the geometry of the MLA.[3]

The algorithm is the result of applying three processes in cascade: a simulated display, a synthetic capture and the homogeneous scaling. To demonstrate the utility of the algorithm, we generated the synthetic integral image ready to be displayed on a monitor whose parameters are very different from the ones used in the capture. For the capture of the elemental images, we prepared the 3-D scene shown in (a) and picked up the elemental images with only one digital camera that was mechanically translated. In (b), we show the captured image, which was composed of 31 × 21 elemental images with 51 × 51 pixels each.



(a) Experimental setup; (b) Integral image obtained experimentally; (c) Collection of synthetic elemental images ready to produce a real orthoscopic image; (d) Reconstruction of the orthoscopic, floating 3-D image through an MP4 device.

Our aim was to produce a synthetic integral image for display in an MP4 device that had a matrix display with 900 × 600 pixels of 79.0 μm each. We calculated a matrix of 75 × 50 elemental images with 12 × 12 pixels each. In (c), we show the calculated integral image. Finally, we displayed the synthetic integral image in the matrix display of the MP4 device over which we placed the microlens array. In order to avoid a braiding effect, we took care to ensure that the distance between the screen and the microlenses was equal to their focal length.[4] As we show in (d), the display produced an orthoscopic floating 3-D reconstruction of the 3-D scene that can be observed with full parallax.



Visit www.opnmagazine-digital.com to view the video that accompanies this article.

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2. J.-H. Park et al. Appl. Opt. **48**, H77 (2009).
3. H. Navarro et al. Opt. Express **18**, 25573 (2010).
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