Masashi OHKAWA, Dr. Eng.

Professor

Program: Electrical and Information Engineering
Area: Human Sciences and Assistive Technology
Undergraduate: Dept. of Biocybernetics

Professional Expertise

He has professional expertise in photonics and optics, especially integrated photonic sensors, holographic memory, and color discrimination. His research group has developed several guided-wave optical sensors with micromachined structures, an optical retrieval system using holographic memory, and a colorimeter using an artificial neural network for the color system conversion.

Research Fields of Interest

Integrated Photonic Sensors

- Pressure sensors
- Microphones
- Accelerometers
- Flow sensors

Holography

- Acrylamide-based photopolymer holographic films
- Optical retrieval system using a holographic memory

Colorimeter

- A colorimeter using a digital camera and an artificial neural network

Education

1989: Doctoral Eng. Degree, Graduate School of Engineering Science, Osaka University, Japan
1986: Master Eng. Degree, Graduate School of Engineering Science, Osaka University, Japan
1984: Bachelor Eng. Degree, Faculty of Engineering Science, Osaka University, Japan

Professional Societies and Activities

1. IEEE (The Institute of Electrical and Electronics Engineers), Member
2. OSA (The Optical Society of America), Member
3. SPIE (The International Society for Optics and Photonics), Member
4. The Institute of Electronics, Information and Communication Engineers, Member
5. The Japan Society of Applied Physics, Member
6. The Optical Society of Japan, Member
7. The Institute of Electrical Engineers of Japan, Member
8. The Laser Society of Japan, Member

Major Publications

Book Chapters

[1] M. Sengoku eds., “Wonders of electricity”, Corona publishing co. ltd. (1995). [in Japanese]

[2] I. Igarashi, M. Esashi and H. Fujita eds., “Microoptomechatoronics handbook,” pp. 153-162 (Sec. 3.3), Asakura publishing co. ltd. (1997). [in Japanese]

Papers (including Conference Papers)

*** Pressure sensors**

[1] “Integrated-Optic Pressure Sensor on Silicon Substrate,” Applied Optics, vol. 28, no. 23, pp. 5153～5157 (1989).

[2] “Silicon-based integrated optic sensor using intermodal interference between TM-like and TE-like modes,” Fiber and Integrated Optics, vol. 21. no. 2, pp.105-113 (2002).

[3] “Sensitivity dependence with respect to diaphragm thickness in guided-wave optical pressure sensor based on elasto-optic effect,” Optical Engineering, vol. 47, 044402-1～5 (2008).

[4] “Sensitivity dependences on side length and aspect ratio of a diaphragm in a glass-based guided-wave optical pressure sensor,” Optics Express, vol. 16, no. 19, pp. 15024-15032 (2008).

[5] “Dependence of Resonance Frequency on Diaphragm Dimensions in a Guided-Wave Optical Pressure Sensor,” IEEJ Trans. SM., vol. 129, no. 10, pp.357-362 (2009). [in Japanese]

*** Microphones**

[6] “An optical microphone using a silicon-based guided-wave optical pressure sensor,” Proc. SPIE, vol. 5728, pp.317-324 (2005).

[7] “Feasibility of a silicon-based guided-wave optical microphone,” *Integrated Photonics and Nanophotonics Research and Applications* (Boston, MA, USA), JMB34 (2008)

*** Flow sensors**

[8] “Sensitivity dependences of silicon-based guided-wave optical flow sensors,” *Integrated Photonics and Nanophotonics Research and Applications* (Honolulu, HI, USA), JTuB7 (2009).

*** Holography**

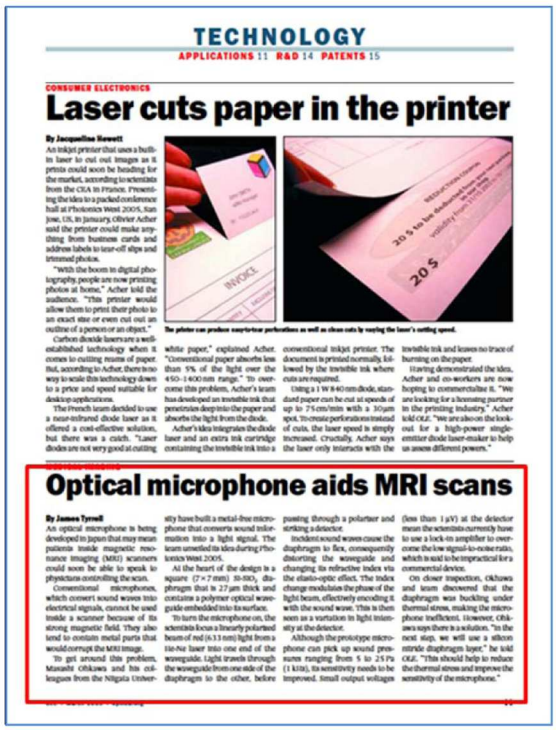
[9] “Fast and highly parallel content addressing of a large amount of information recorded in a holographic memory,” Appl. Opt., vol. 33, no. 14, pp. 3003-3009 (1994).

[10] “Stability of holographic gratings recorded in photopolymer films using different dyes,” Proc. SPIE, vol. 6136, pp.613610-1～8 (2006).

[11] “Holographic characteristics of two different films using methyl violet dyes in polyvinyl alcohol matrices,” Optical Engineering, vol. 46, no. 1, pp. 01580-1～6 (2007).

*** Colorimeter**

[12] “Evaluation of the artificial neural network for color discrimination - Discrimination of non-learned colors -,” J. Light & Vis. Env., vol. 28, no. 2, pp. 101-103 (2004).



TECHNOLOGY

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CONSUMER ELECTRONICS

Laser cuts paper in the printer

By Jacqueline Hewett

An inkjet printer that uses a built-in laser to cut out images as it prints could soon be heading for the market, according to scientists from the CEA in France. Presenting the idea to a packed conference hall at Photonics West 2005, San Jose, US, in January, Olivier Acher said the printer could make anything from business cards and address labels to tear-off slips and trimmed photos.

"With the boom in digital photography, people are now printing photos at home," Acher told the audience. "This printer would allow them to print their photo to an exact size or even cut out an outline of a person or an object."

Carbon dioxide lasers are a well-established technology when it comes to cutting reams of paper. But, according to Acher, there is no way to scale this technology down to a price and speed suitable for desktop applications.

The French team decided to use a near-infrared diode laser as it offered a cost-effective solution, but there was a catch. "Laser diodes are not very good at cutting white paper," explained Acher. "Conventional paper absorbs less than 5% of the light over the 450–1400 nm range." To overcome this problem, Acher's team has developed an invisible ink that penetrates deep into the paper and absorbs the light from the diode.

Acher's idea integrates the diode laser and an extra ink cartridge containing the invisible ink into a conventional inkjet printer. The document is printed normally, followed by the invisible ink where cuts are required.

Using a 1 W 840 nm diode, standard paper can be cut at speeds of up to 75 cm/min with a 30 μm spot. To create perforations instead of cuts, the laser speed is simply increased. Crucially, Acher says the laser only interacts with the invisible ink and leaves no trace of burning on the paper.

Having demonstrated the idea, Acher and co-workers are now hoping to commercialise it. "We are looking for a licensing partner in the printing industry," Acher told OLE. "We are also on the lookout for a high-power single-emitter diode laser-maker to help us assess different powers."

Optical microphone aids MRI scans

By James Tyrrell

An optical microphone is being developed in Japan that may mean patients inside magnetic resonance imaging (MRI) scanners could soon be able to speak to physicians controlling the scan.

Conventional microphones, which convert sound waves into electrical signals, cannot be used inside a scanner because of its strong magnetic field. They also tend to contain metal parts that would corrupt the MRI image.

To get around this problem, Masashi Ohkawa and his colleagues from the Niigata University have built a metal-free microphone that converts sound information into a light signal. The team unveiled its idea during Photonics West 2005.

At the heart of the design is a square (7 × 7 mm) Si-NO_3 diaphragm that is 27 μm thick and contains a polymer optical waveguide embedded into its surface.

To turn the microphone on, the scientists focus a linearly polarized beam of red (633 nm) light from a He-Ne laser into one end of the waveguide. Light travels through the waveguide from one side of the diaphragm to the other, before passing through a polarizer and striking a detector.

Incident sound waves cause the diaphragm to flex, consequently distorting the waveguide and changing its refractive index via the elasto-optic effect. The index change modulates the phase of the light beam, effectively encoding it with the sound wave. This is then seen as a variation in light intensity at the detector.

Although the prototype microphone can pick up sound pressures ranging from 5 to 25 Pa (1 kHz), its sensitivity needs to be improved. Small output voltages (less than 1 μV) at the detector mean the scientists currently have to use a lock-in amplifier to overcome the low signal-to-noise ratio, which is said to be impractical for a commercial device.

On closer inspection, Ohkawa and team discovered that the diaphragm was buckling under thermal stress, making the microphone inefficient. However, Ohkawa says there is a solution. "In the next step, we will use a silicon nitride diaphragm layer," he told OLE. "This should help to reduce the thermal stress and improve the sensitivity of the microphone."

An article on our guided-wave optical microphone in “Opto & Laser Europe (March 2005, Issue 126, p.11).”