Colorado State University's Information Science and Technology Center (ISTeC)

Presents

Dr. Emmett Leith

University of Michigan Department of Electrical Engineering and Computer Science

(one of the first holographic images, April 1964)

Tuesday, May 4, 2004

ISTeC Distinguished Lecture

"Making the Invisible Visible with Holographic Information Processing"

2:30 p.m.

Colorado State University Campus
Lory Student Center, Room 230
Reception at 2:00 p.m.

and

Wednesday, May 5, 2004

Electrical and Computer Engineering Seminar

"Holography, Synthetic Apertures, Optical Sectioning, and Photon Migration: Cross-Fertilizations"

9:30 a.m.

Colorado State University Campus
Lory Student Center, Room 228
Reception at 9:00 a.m.

Lectures are free and open to the public

ABSTRACTS

"Making the Invisible Visible with Holographic Information Processing"

X-rays (mammograms), ultrasound, CAT scans and other medical diagnostics extract information about disease in body tissue. Visible light has some attractive possibilities compared to these other techniques: it is potentially much less expensive, and unlike x-rays, is harmless. But the obstacle is that biological tissue is, for light, a highly scattering medium – in other words, tissue transmits light like shower glass so that you can't see through it. To circumvent this problem and permit the viewing of objects in tissue, various techniques based on sophisticated information processing concepts, have been developed. These techniques allow the seemingly impossible to happen – ideally, rendering biological tissue that was once impossible to see through to be as transparent as window glass. With such a technique, we could look into living tissue and discern anomalies such as malignant tumors. This ultimate goal is quite visionary; nonetheless, what has been achieved is encouraging. In this talk we discuss various optical holography techniques that we have explored for peering into scattering media and making obscured objects visible. We calculate the basic limitations of the process, i.e., how thick and how scattering can the medium be before the techniques fail. Finally, we discuss the prospect of applying these techniques to the detection of tumors.

"Holography, Synthetic Apertures, Optical Sectioning, and Photon Migration: Cross-Fertilizations"

A good way to make scientific discoveries is concept transfer across boundaries of different disciplines. The above-noted disciplines are basically distinct, but with some similarities. All are well described by the concepts of information optics, and such an approach leads to interesting cross-

fertilizations. Some of the successes to date will be described, along with speculations on further possibilities.

Dr. Emmett Leith

Dr. Emmett N. Leith was born in 1927 and received the BS and MS in physics and the PhD in electrical engineering, all from Wayne State University, Michigan, and also an honorary Doctor of Science degree from University of Aberdeen. He has been employed by the University of Michigan since 1952, and has also worked at ERIM, in Ann Arbor, Michigan. His research has been in the areas of synthetic aperture radar, optical processing and holography. His work on optical information processing of synthetic aperture radar data led him to independently discover the principles of holography in the mid-1950's. Leith made this development unaware of the work of Gabor, who ~ 8 years earlier had proposed "in-line" holography. Leith's theory drew upon physical optics and information theory. This interdisciplinary theory made it clear how to solve problems that had plagued Gabor's original work that was based on a different theoretical architecture. The work of Leith made holography an active area of research, resulting in widespread applications. Perhaps the most astounding feature of the holography developed by Leith is the ability to capture truly three-dimensional images (an impossible feat with Gabor's technique). The image of the train show here is, in fact, a holographic reconstruction of the first holographic recording of a three-dimensional object ever taken (by Leith and Upatnieks). Prof. Leith has authored or coauthored about 200 papers. He is listed in various publications, such as Who's Who in America. He is a fellow of IEEE, the Optical Society of America and the SPIE, and is an honorary member of the Engineering Society of Detroit. He has received numerous awards, including the Liebmann Award of IEEE, the Herbert Ives Medal of OSA, the Gold Medal of SPIE, the Progress Medal of the Royal Photographic Society of Britain, and the National Medal of Science. He is a member of the National Academy of Engineering. Please see http://www.eecs.umich.edu/OSL/Leith/ and http://www.engin.umich.edu/alumni/engineer/03FW/research/holography/ for more information.

To arrange a meeting with the speaker, please contact Dr. Randy Bartels at (970)491-1464 or bartels@engr.colostate.edu

Information Science and Technology Center (ISTeC)

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