Optical Security

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This special section of *Optical Engineering* marks an important first: It is the first one devoted to the topic of optical security, encryption, and verification. True, the field has been around a long time, from the days of watermarks and intaglio printing. With advances in technology, such as lasers, holograms, and digital electronics, the state of the art in security and encryption has advanced. Unfortunately the same technical advances have fueled a huge increase in fraud and counterfeiting.

It is interesting to see how the field has grown in the short time since we became interested in it about four years ago. SPIE has hosted three symposia in this area, chaired by van Renesse. This year, Javidi chaired a workshop, sponsored by the NSF, DARPA, and the USAF, on the role of optics in security, encryption, and anticounterfeiting. The workshop report will provide guidelines for government funding and support of this field. There was an entire conference, the CardTech/SecureTech conference in Atlanta, which was devoted just to card security, e.g., credit cards, smart cards (containing IC chips), drivers licenses, identification cards, immigration cards, etc. It was attended by nearly 6000 people (even though the registration was more than double the SPIE registration and many of the participants were from small businesses). In addition, a consortium of government laboratories and agencies working in the field was formed in 1992—the ''Biometric Consortium''—to exchange information and also in hopes of opening a center for biometric technology research. Even the *New York Times* had an article in their science section recently on quantum encryption—a very new and highly imaginative approach to the problem.

While the state of digital encryption and encoding has certainly advanced, it is generally agreed that ultimately to produce secure and noncounterfeitable products, a biometric identification must be included. This includes fingerprints, hand geometry, iris or retinal patterns from the eye, facial images, vein patterns from the hand, voice prints, etc. At the CardTech/SecureTech conference, vendors were displaying and marketing equipment for the first four mentioned techniques. Optics can play a big role in this rapidly growing field. It is already. This includes optical systems to read the card and live biometric data, to manufacture the card, and hybrid optical processing systems to read and verify the data on the card, possibly from a large optical database.

In this special section, we feel that we have been fortunate to receive articles that included a wide sampling of papers from many aspects of this technology. In the order presented, this includes encryption techniques; devices for reading biometric data; papers on fabrication, testing, and evaluation of actual verification; and authentication systems. We hope the readers will be inspired by these articles to try and adapt their own areas of technical competency to this important ever-growing field.

We would like to thank all of the authors for their fine contributions, the reviewers for their efforts, Brian Thompson for providing the opportunity to do a special section on this subject, and the SPIE staff for their supportive patience. And last, but not least, we thank Dr. Guanshen Zhang, a postdoctoral student at the University of Connecticut, Department of Electrical Engineering, for his help in obtaining the reviews of the papers. Without the unflagging efforts of all the above, we never could have gotten the job done.

Joseph L. Horner received his BS degree from Haverford College and an MS degree from Bryn Mawr College, both in physics. After working for three years in industry, he enrolled at the University of Michigan, receiving his PhD degree in 1968. He received a NRC postdoctoral fellowship to NASA/ERC, Cambridge, Massachusetts, which later became the DOT Transportation Systems Center. He left there in 1976 to become a consultant to Dr. Edwin Land at Polaroid Corporation. In 1978 he joined Rome Laboratory. He holds 25 patents, has published his second book on optical signal processing, received the AF Basic Research Award in 1990, was named to the Aviation Week Laurels List in 1991, and received the 1992 ''Inventor of the Year Award'' from the Inventors's Association of New England. In addition to signal and image processing, Dr. Horner has also done work in holography, which culminated in his invention of a series of holographic optical elements as couplers and demultiplexers for fiber optic systems. He is the co-inventor, with H. John Caulfield, of the phase-only filter. Dr. Horner is a fellow of the Optical Society of America and SPIE.

Bahram Javidi is a full professor of electrical engineering at the University of Connecticut. His research interests include optical information processing, pattern recognition, neural networks, digital image processing, and communication systems. In 1990, he was named a Presidential Young Investigator by the National Science Foundation; in 1993, he was named a Fellow of SPIE; and in 1996, he was named a Fellow of the Optical Society of America. He is the author of *Real-time Optical Information Processing*, published in 1994 by Academic Press, and has more than 70 refereed articles in major optical journals and more than 80 papers in conference proceedings on optics. He is the topical editor of the IEEE Press Book Series on Imaging Science and Engineering, chairman of the IEEE Lasers and Electro-Optics Society Technical Committee on Electro-Optics Systems, chairman of the Optical Processing and Computing Working Group of the Optical Engineering Society, and a frequent guest editor for major journals on optics. He is a consultant to industry, and panelist for the National Research Council and the National Science Foundation.