Guest Editorial

Electro-Optical Imaging

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Electro-optical imaging has extended man's capability to observe his world beyond the dreams of science fiction writers of just one generation ago. Man has placed his eyes on the surface of the moon, Venus, and Mars—spacecrafts took fascinating closeup pictures of Mercury and Jupiter. Who was not awed by seeing the earth rising above the rugged mountain ranges of the moon?

But the vastly extended observation range provided by electro-optical systems is only one of three major capabilities which make these devices unique. The other two—sometimes overlooked, but still as important to the scientist and engineer—are the dramatic increases in sensitivity and the continuous coverage of the electro-magnetic spectral range from X rays to the long wavelength infrared. Thermal images—where familiar objects take on rather unfamiliar, ghost-like appearances—have a similar fascinating effect on people, as the first x-ray pictures must have had when they were published about eighty years ago.

Electro-optical imaging in its most familiar form, commercial television, had the most profound influence on our life style. The technical quality of TV, its resolution and good color representation are taken for granted today. How many people still recall the small green picture tube only a few inches across?

It would have been impossible to exploit the potential of electro-optical imaging without the combination of electro-optical technology and worldwide communication systems. We have come a long way and we take technical marvels in stride. How often do we pause and think: when in our own living rooms we become real-time observers of sports events taking place somewhere half way around the world; when we watch the news presented by "Our correspondent in . . ." three thousand miles away; when we watch a weather forecast and see the satellite pictures of cloud combinations move across the U.S.?

I am convinced one has to look at the first map of the continental United States, composed completely from satellite pictures, to feel the impact of this new technology. This unusual map, published and prepared by the *National Geographic* in connection with the General Electric Company from pictures obtained by NASA, brings home some of the very practical aspects electro-optical systems provide beyond commercial television.

There is hardly any field in science and engineering which is not affected by advances in electro-optical imaging technology—medicine with x-ray conversion devices, low-light level systems and thermal radiography; closed-circuit television security sys-

tems in law enforcement; large-scale introduction of electro-optical imaging systems in astronomy and spectroscopy; automatic reading and identification systems—these are only some of the more recent applications.

The particular property of electro-optical imaging devices to convert the spatial energy distribution of an optical image into a time variant amplitude-modulated signal opened the door to automatic, real-time signal processing. Electro-optical imaging systems can be connected to a computer directly with an almost limitless variety of processing options.

Yet the device technology is advancing still, and *Optical Engineering* devotes this special issue to this fascinating field. Nine excellent papers demonstrate the diversification which we see today. It is no accident that four of the papers deal with the new family of charge transfer devices. The paper by R. D. Nelson describes the development and systems applications of IR sensitive silicon charge transfer devices. S. Iwasa deals with the task to couple photovoltaic detectors to a charge transfer device multiplexer to obtain imaging devices for the 5 μm region. In a companion paper, T. J. Tredwell reports his work with photodiode arrays for the 2 μm region. A different approach is the subject of the paper by J. P. Choisser describing an electro-optical intensifier/charge transfer device combination to achieve multichannel photon counting. Many of the difficulties which arise from the finite detector size in charge transfer devices and detector arrays are analyzed by S. B. Campana. Designers who have to choose between solid state sensor arrays and vacuum tube devices will find convincing arguments and many facts in J. A. Hall's paper comparing the two classes of devices and their proper applications.

The capacity of the high resolution television system and its most impressive representative—the return beam vidicon—is described by M. J. Cantella. Readers will find an interesting analysis of thermal imaging systems and their radiometric accuracy in a paper by I. R. Abel. Finally, the paper by W. C. Bradley gives us an insight into the problems which have to be solved when television sensors are employed in astronomy to detect point sources from a spaceborne telescope.

As editor of this special issue on electro-optical imaging devices, I would like to thank my colleagues for their cooperation in providing their interesting papers and helping me to meet a tight schedule.