Guest Editorial

Applications of Optical Instrumentation in Medicine

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Exciting developments are underway in x-ray, radionuclide and optical imaging for medical diagnosis. Many of these developments were discussed this past November in Chicago at the Second SPIE Technology Utilization Seminar on Application of Optical Instrumentation in Medicine. As examples of these discussions, five papers have been selected for inclusion in this issue of *Optical Engineering*. All papers presented at the seminar are printed in the Seminar Proceedings.

In the first paper, Akcasu, *et al.*, at the University of Michigan discuss their work with coded apertures and x-ray film as an alternative to collimators and scintillation detectors for gamma-ray imaging in nuclear medicine. The authors discuss the advantages of time-modulated coded apertures over stationary apertures, and support their discussion with images obtained with a 121 element code plate mounted on a scintillation camera. Limitations of time-modulated apertures include difficulties in achieving the high frame rates required for rapid dynamic studies, and high capacity data storage and long computing times needed for image reconstruction. Nevertheless, this approach to nuclear medicine imaging is interesting, particularly for certain source distributions such as small organs and, possibly, the skeleton.

The second paper in the series, authored by Kaufman and his associates in San Francisco and Berkeley, describes the pressurized multiwire proportional chamber and its possibilities for nuclear medicine imaging. By increasing the pressure of 93 percent Xe – 7 percent CO_2 gas in the detector to 4 atmospheres, improvements have been achieved in both detection efficiency and spatial resolution. For example, a chamber operated at 4 atmospheres provides a modulation transfer function for 140 keV photons which resembles that for 22 keV photons interacting in a 1 atmospheric chamber. To overcome further the poor detection efficiency of the gas-filled multiwire proportional counter for photons of clinically useful energies, the authors are constructing a 30 x 30 cm^2 chamber to be operated at 10 atmospheres.

In the third paper, Kilgore, Gregg and Rao continue their investigation of the usefulness of image enhancement for the visualization of soft tissue tumors. The authors show that xeroradiography, an enhancement technique generally accepted for mammography, suppresses lower spatial frequencies and accentuates higher frequencies in the region of one line pair per millimeter. These effects tend to enhance the visualization of small calcifications, blood vessels, and other structures of diagnostic interest in mammography.

Mistretta has addressed the general problem of image enhancement by developing an x-ray transmission function which can be separated by a Taylor's series expansion into a number of terms. By accentuation and suppression of various terms, different approaches to image enhancement may be simulated. The author suggests that this approach provides a convenient classification scheme for various image enhancement procedures, and emphasizes that the expression "image enhancement" can be misleading if the particular enhancement technique is not identified succinctly.

In the last paper in the series, Epstein at Northwestern University describes his work on the development of a multifiber hypodermic fiberscope. This work has led to a fiberscope which is housed in a probe within stainless steel tubing of 1.25 mm diameter, corresponding to a gage 18 hypodermic needle. The imaging multifiber consists of 11,000 optical fibers, each with a diameter of 5 microns. The multifiber can be moved relative to a pair of plano-convex lenses at the distal end of the probe, providing a range of focal depths, fields of view and magnifications. Also contained within the 1.25 mm diameter tubing is an illumination fiber optic bundle consisting of 212 individual glass fibers. Applications of the hypodermic fiberscope include visually controlled percutaneous needle biopsy of pleural, rib and lung tissue, and exploration of benign renal cysts.