GUEST EDITORIAL

Special Section on Imaging Through Scattering Media

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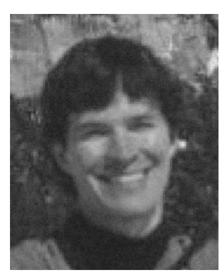
There are many practical situations and imaging modalities where there is significant scatter due to the media being studied. While solutions may involve circumventing the obscuring scatter, there are important new approaches that image based on the scattering properties. This latter category includes optical imaging in tissue, as well as in aerosol and turbid fluid applications, where the scatter may be high but the absorptive losses modest. In many situations, a Boltzmann transport equation or in some cases the simpler diffusion equation may be suitable as forward models in imaging algorithms. In this case, imaging can be treated as an optimization problem, where an image is formed based on the spatial variations of absorption and scatter. This field has become known as optical diffusion tomography (ODT).

Other than cost and performance motivations, the primary reason to use light for imaging is the spectroscopic information available. Media of interest, such as tissue, have important properties, as well as relatively low absorption, in the infrared wavelength range. By making measurements at a number of wavelengths, blood chemistry information can be garnered. By using fluorescence, additional contrast can be achieved. With appropriate targeting, fluoresence data with a suitable imaging approach may provide a means to safely detect tumors at an early stage.

This special section has four papers dealing with imaging in scattering media using light. In ''Image reconstruction in optical tomography using local basis functions,'' Schweiger and Arridge present a comparison of local basis functions in a finite element representation of the diffusion equation forward model in ODT. The image formed on inversion is dictated by these basis function weights, so the quality of the image will be a function of the character, for example, the order and discretization level, of the local basis functions. In ''Three-dimensional optical tomography with the equation of radiative transfer,'' Abdoulaev and Hielscher use the Boltzmann transport equation directly for optical imaging in scattering media. This allows imaging in applications where the diffusion equation does not hold, but where there is still significant scatter. In ''Application of transform algorithms to high-resolution image reconstruction in optical diffusion tomography of strongly scattering media,'' by Konovalov *et al.*, back projection techniques are investigated for ODT applications and compared with a solution achieved by inverting the diffusion equation. Good quality images are shown using this approach, without capturing all the physics, with very little computational effort. In ''Near-infrared breast tomography calibration with optoelastic tissue simulating phantoms'' by Jiang *et al.*, the imaging performance of a diagnostic tool is evaluated, along with phantom models for tissue that can be used in instrument calibration.



David A. Boas studied physics and received his BS at Rensselaer Polytechnic Institute and his PhD at the University of Pennsylvania. For his dissertation he received the Burstein Prize in Condensed Matter Physics. He has been an assistant professor of radiology at Harvard Medical School during the last 5 years where he directs the Photon Migration Imaging Laboratory within the Anthinoula A. Martinos Center for Biomedical Imaging at Massachusetts General Hospital. This lab consists of 25 faculty, fellows, students, and staff advancing photon migration technologies for application to brain function and breast cancer.

Charles A. Bouman received a BSEE degree from the University of Pennsylvania in 1981, and a MS degree in electrical engineering from the University of California at Berkeley in 1982. From 1982 to 1985, he was a staff member in the Analog Device Technology Group at MIT, Lincoln Laboratory. In 1987 and 1989, he received MA and PhD degrees in electrical engineering from Princeton University under the support of an IBM graduate fellowship. In 1989, he joined the faculty of Purdue University where he holds the rank of professor with a primary appointment in the School of Electrical and Computer Engineering and a secondary appointment in the Department of Biomedical Engineering. Professor Bouman's research focuses on the use of statistical image models, multiscale techniques, and fast algorithms in applications including multiscale image segmentation, tomographic image reconstruction, image printing and rendering, and document segmentation and compression. His research has resulted in new methods for image rendering, halftoning, and display that have been widely used in commercial products. He has authored over 39 journal publications, over 100 conference publications, and is an inventor on six issued patents. He has performed research for numerous government and industrial organizations including the National Science Foundation, the US Army, Hewlett-Packard, Xerox, NEC Corporation, Apple Computer, and Eastman Kodak. Professor Bouman is a fellow of the IEEE and a member of the SPIE and IS&T professional societies. He has been an associate editor for the *IEEE Transactions on Image Processing* and the *IEEE Transactions on Pattern Analysis and Machine Intelligence*. He has also been the awards chair for the ICIP 1998 organizing committee, co-chair of the SPIE/IS&T conference on Visual Communications and Image Processing 2000 (VCIP), and a member of the IEEE Image and Multidimensional Signal Processing Technical Committee. Currently, he is the vice president of publications and a member of the board of directors for IS&T, and he is the founder and co-chair of the SPIE/IS&T conference on computational imaging.

Kevin J. Webb is a professor in the School of Electrical and Computer Engineering at Purdue University. He received BEng and MEng degrees from the Royal Melbourne Institute of Technology in 1978 and 1983, respectively, the MSEE from the University of California, Santa Barbara, in 1981, and a PhD from the University of Illinois, Urbana, in 1984. During calendar year 2003 he is a visiting professor at the Massachusetts Institute of Technology.