The Washington Academy of Biomedical Engineering
2004-2005 Workshop Series

Co-Sponsor:
Howard University
Department of Electrical and Computer Engineering

Functional Imaging: Modalities and Applications

Presentations by:

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Tuesday, April 5, 2005 from 4:30 pm - 6:30 pm (Reception following)
The Marvin Center, 3rd floor Amphitheatre
The George Washington University
21st and H Streets NW, Washington, DC
Metro: Foggy Bottom/GWU *Parking: GW garage, 22nd and I Streets*

For further information, contact the registration coordinator, Kenneth H. Wong, Ph.D., at 202-784-1521. This workshop is supported in part by grants from the U.S. Army TATRC (Telemedicine and Advanced Technology Research Center) and The Whitaker Foundation. The workshop is free and open to the public. The Marvin Center is an accessible facility.

Workshop Abstracts

Bernard Mair's Abstract

Gated cardiac emission computed tomography is a useful procedure for diagnosing coronary artery disease. A diagnosis is made on the basis of a sequence of three dimensional images of myocardial perfusion or metabolism at different phases of the cardiac cycle and on important functional parameters such as ejection fraction and myocardial wall motion. The short imaging time and cardiac motion result in a reduced signal to noise ratio, and significant motion blur in the reconstructed images. As a result, there is significant interest in developing motion-compensated image reconstruction techniques.

In this talk we discuss how to combine the image reconstruction and wall motion estimation in a single algorithm by modeling the myocardium as a deformable elastic material. A novel feature of this method is that it forces the reconstructed images to be influenced by the motion estimates. The method may be viewed as a penalized maximum likelihood image reconstruction method with penalty terms determined by (1) an image matching term that ensures a measure of agreement between the gated images and (2) the strain energy of the elastic material model for the heart wall. Simulations will be presented to demonstrate the feasibility of the proposed method.

John Haller's Abstract

"In biological systems, what we call structure are slow processes of long duration; what we call function are fast processes of short duration." - Arthur Koestler

The distinction between structural and functional imaging can be thought of in relation to the duration of biological processes. For example, the slow growth of a tumor and the subsequent displacement of anatomic *structure* is a diagnostic sign of cancer. Alternatively, fast metabolic activity can be seen in *functional* images of tumors. Thus, both structural and functional images provide different kinds of information about related phenomena such as tumor growth and activity. Traditionally, MRI and CT have been thought of as structural images, and PET has provided functional images. However, these structure vs. function distinctions between image modalities have become more blurred in the last decade or more. In the past, conventional radiology has focused largely on the structural (anatomic) correlates of disease. However, as the 21st Century progresses, greater emphasis is being placed on functional - especially physiological and molecular - correlates of disease. Molecular imaging modalities, such as PET and optical imaging, may be considered functional imaging techniques, and hold great promise for better defining disease *specificity*. Future molecular imaging technologies may one day be able to detect disease before the slow appearance of anatomic changes seen in structural images that are often too late in detecting disease. Nonetheless, it is clear that structural imaging will continue to play an important role, and the synergistic fusion of anatomic structure and physiological function will be critical for the diagnosis and treatment of disease. Examples of the importance of functional imaging can already be seen in studies of Alzheimer's disease, schizophrenia, and with increasing use in image-guided interventions.

About WABME

The Washington Academy of Biomedical Engineering, founded in 2003, is a consortium whose charter membership is composed of faculty from academic institutions in Washington, D.C.: The George Washington University, Catholic University of America, Georgetown University, and Howard University. The goal of WABME is to promote collaboration, research, technology transfer, and education in biomedical engineering. This collaborative endeavor is designed to strengthen existing BME research programs and to create new scientific pathways for future discovery. Further information is available at www.wabme.org.