



Institute for Pure and Applied Mathematics University of California, Los Angeles presents

Heart Modeling: Image Acquisition. Segmentation, Modeling and Analysis February 6 - 10, 2006

Organizing Committee: **Dimitris Metaxas**, Chair (Rutgers University), **Leon Axel** (New York University Medical Center), **James Duncan** (Yale University), **Jerry Prince** (Johns Hopkins University)

Scientific Overview

The understanding of the heart's mechanics is crucial in clinical research for diagnosis and patient study. The imaging techniques, such as Magnetic Resonance Imaging (MRI), Ultrasound, CT, and X-ray provide noninvasive methods to study internal organs in vivo. Typically 2-D slices are combined to generate a 3-D volumetric model. Furthermore the images taken over time make 4-D (3-D + time) analysis possible. Accurate and expedient interpretation of this data is difficult to achieve. These modalities provide a tremendous amount of data and when presented as 2D images typically require an expert anatomist to interpret. Moreover, comprehensive understanding of diastole and systole is difficult because the heart moves some structures become invisible and then visible again as they move through the image planes acquired by the scanner. Image interpretation is further confounded by motion artifacts from the subject. The cost incurred in manual interpretation of the data by a cardiology/radiology specialist is prohibitive for routine data analysis; however an automated analysis system holds the promise of reducing interpretation costs. It also paves the way for objective, quantitative analysis rather than a subjective, qualitative analysis. In addition an automated analysis system may be used to give evidence of a correlation between particular diseases and the regional changes in the shape and motion of the heart.

This workshop will cover the most recent efforts by several research groups towards improved data acquisition, data analysis, 3D shape and material modeling, hemodynamics and electrophysiology. In particular the workshop will cover:

- Imaging Modalities such as MRI, MRI-tagging and Ultrasound that are currently being used clinically and in research labs for data acquisition and the properties of these data.
- Low level segmentation methods to extract the epicardium and the endocardium for the Left and the Right Ventricles, as well as the papillary muscle and the valves.
- Heart anatomy and physiology, various diseases and 3D modeling methods
- Estimation of the 3D heart anatomy from various modalities
- 3D analysis of the shape and motion during the cardiac cycle
- Estimation in vivo and in vitro of the heart's material properties
- Relationship between the wall motion and disease
- Hemodynamics and related challenges (description of the existing efforts)
- Electrophysiology and its relationship to the heart's fibers and deformation

The topics will be covered by various experts in this field carefully selected to address both the underlying mathematics and the related applications. Speakers will include mathematicians, computer scientists, bioengineers and physicians.

Participation:

We have funding to support the attendance of recent PhD's, graduate students and researchers in the early stages of their career. Mathematicians and scientists at all levels who would like to learn more about this area are encouraged to apply for funding. Encouraging the careers of women and minority mathematicians and scientists is an important component of IPAM's mission and we welcome their applications.

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