Analyzing 3-D Video Ultrasound of the Heart

ANDREW F. LAINE

Professor of
Biomedical Engineering
and of Radiology

Heart disease is the nation's leading cause of death. About 80 million Americans suffer from at least one form of cardiovascular disease, and each year about 900,000 people die from it. To understand stages of this disease, Andrew Laine and his team are analyzing real-time video 3-D ultrasounds of the heart. Ultrasound echoes are high-frequency sound waves that bounce off tissues and can be converted into sonograms.

"Recent advances in real-time 3-D ultrasound (RT3-D or 4-D) imaging give us a wealth of dynamic information captured in seconds over the entire cardiac cycle," said Laine. "With the proper analytic tools it can provide a novel and clinically effective 3-D strain-and-torsion measuring tool that will allow cardiologists to routinely measure cardiac wall motion and strain with reliable accuracy."

The modality of real-time 3-D ultrasound imaging has many advantages since it is portable, non-invasive, and doesn't require exposure to X-rays as in CT imaging systems. Cardiac MRIs by contrast are far more expensive and lack real-time processing. By using real-time 3-D ultrasound technology for both screening and treatment of heart disease, we can reduce health care costs while improving the quality of patient outcome.

Ultimately, Laine and his colleagues will develop software that will be able to measure the strain on the muscles of the heart in real-time 3-D and localize infarcted or ischemic tissue that could be salvaged by intervention and thus recognize at an early stage what tissue is damaged or at risk.

"By visualizing and evaluating strain exerted by functioning heart muscle comprising the cardiac wall using 4-D ultrasound," he said, "we hope to detect previously undiscovered cardiac myopathies, as well as more subtle changes over time that will allow us to better quantify cardiac function."

Laine, who received his D.Sc. degree from Washington University in computer science, teaches courses on Medical Image Analysis to graduate students and Wavelet Applications in Medicine to undergraduate students. He serves as vice president of publications for IEEE Engineering in Medicine and Biology Society (EMBS), the largest professional society in the field, and is chair of the Technical Committee on Biomedical Imaging and Image Processing for IEEE EMBS.

Laine holds two patents related to 3-D processing of ultrasound, has authored over 300 peer-reviewed papers, and has graduated over 20 doctoral students in the field of medical image analysis. He is a fellow of the IEEE and fellow of the American Institute of Medical and Biological Engineering.

B.S., Cornell, 1977; M.S., University of Connecticut, 1980; M.S., Washington University (St. Louis), 1983; D.Sc., Washington University, 1989