

Ultrasound Imaging Systems: from Principles to Implementation

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The design of medical ultrasound imagers is undergoing important changes brought about by advances in semiconductors and signal/image procession technologies. These changes are happening with simultaneous changes in medical practice and the utilization of medical imaging in general. Unique aspects of data acquisition and processing in the ultrasound scanner enable opportunities unavailable to other imaging modalities; key one of these being miniaturization. The goal of this course is to review the system design of ultrasound scanners from a linear systems point of view including transduction, beam formation, and image formation functions. The key points to be covered deal with methods of analysis of array data, the interaction of transmit and receive beams with clinically relevant targets, and how this interaction is used in the generation of clinically useful images. This review will be placed in the context of several growth and research areas for medical ultrasound including 3D/4D imaging and strategies for multi-line acquisition. The last several years have seen steady migration of system functionality from hardware into software; this has enabled significant miniaturization of scanners. The impact of this on system design and the size of ultrasound scanners of the future and their application will be discussed.

Short Bio

Kai E. Thomenius is a Chief Technologist in the Imaging Technologies Organization at General Electric Global Research facility in Niskayuna, NY, USA. His focus is on Ultrasound and Biomedical Engineering. Previously, he has held senior R&D roles at ATL Ultrasound Inc., Interspec Inc., Elscint Inc., as well as other ultrasound companies. In addition, he is currently an Adjunct Professor in the Electrical, Computer, and Systems Engineering Department at Rensselaer Polytechnic Institute where he teaches a course in general imaging. Dr. Thomenius' academic background is in electrical engineering with a minor in physiology; all of his degrees are from Rutgers University. His long-term interests have been in ultrasound beam formation and miniaturization of ultrasound scanners, propagation of acoustic waves in inhomogeneous media, and determination of physiological information from the echoes that arise from such beams. Dr. Thomenius is a Fellow of the American Institute of Ultrasound in Medicine.