AbstractID: 11937 Title: Development of High Frequency Ultrasound Transducers for Medical Imaging

Ultrasonic imaging is one of the most important and still growing diagnostic tools today. Ultrasonic imaging is more appealing as a clinical imaging modality compared to such imaging modalities as magnetic resonance imaging (MRI), nuclear imaging, and x-ray computed tomography (CT) in that it is more cost-effective, non-invasive, capable of real-time operation, and portable while providing images of comparable quality and resolution. State-of-the-art ultrasonic scanners offer real-time gray scale images of anatomical detail with millimeter spatial resolution superimposed on which is a map of Doppler blood flow information displayed in color. Clinical applications of these devices are still expanding and the operating frequencies of these devices seem to inch higher and higher.

High frequency (HF) ultrasound (>20 MHz) yields improved spatial resolution at the expense of a shallower depth of penetration. There are a number of clinical problems that may benefit from high frequency ultrasonic imaging. Intravascular imaging with probes mounted on catheter tips at frequencies higher than 20 MHz with the highest frequency being 60 MHz has been used to characterize atherosclerotic plaque and to guide stent placement and angioplastic procedures. The medical efficacy of ultrasonic imaging of anterior segments of the eye at frequencies higher than 50 MHz in diagnosing glaucoma and ocular tumors and in assisting refractive surgery has been demonstrated. Applications in dermatology for defining tumor involvement and for monitoring treatment, in vascular surgery for characterizing atherosclerotic plaques, and in small animal imaging are also being investigated.

To further expand the role of HF ultrasound, probe performance must be improved since current HF ultrasound imaging devices, dubbed “ultrasound biomicroscopes” or “UBMs” by a number of investigators use mechanically scanned single element transducers. Compared to electronic scanning with linear arrays, mechanical scanning of a single element transducer has three major drawbacks: poorer resolution, slower frame rate, and motion of the probe. Single element transducers can only produce beams with a fixed focus which means the spatial resolution of the device is best only within the depth of focus, i.e., in a very tight zone and degrades rapidly beyond the focal point. Mechanical motion of the transducer limits the frame rate, is unreliable, and may cause discomfort and, at worst, hazard to the patient.

My presentation will introduce several HF ultrasound transducers currently being developed by the NIH Transducer Resource Center at the University of California. Emphasis will be placed on the construction and implementation of high frequency array transducers.

Learning Objectives:
1) Familiarize audience with high frequency ultrasound transducers and their applications.