

**ACOUSTICS2008/2608**  
**Ultrasonic transducers for imaging and therapy based on**  
**time-reversal principles**

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Focusing of ultrasonic waves is a fundamental aspect of most of the medical applications of ultrasound. There are three approaches in focusing acoustic energy: geometrical, using concave transducers and acoustic lenses, electronic, using phased arrays, and time-reversal (TR), which allows both spatial and temporal concentration of acoustic energy. The aim of this talk is to make comparative analysis of advantages and disadvantages of ultrasound focusing techniques, demonstrate unique capabilities of TR focusing in medical imaging, surgery and therapy. Examples of embodiments of ultrasonic focusing transducers utilizing TR method for various biomedical applications will be presented. TR ultrasonic transducers are comprised of a reverberation chamber, which could be either an aluminum block or a water filled volume of irregular shape, and one or several piezotransducers attached to or incorporated in the reverberator. Optimization of the TR transducers for a particular application is considered, including the geometry of the TR reverberator, shape, type and dimensions of the piezotransducers. Unique abilities of TR transducers to steer the focal spot in 3D, produce pulses with arbitrary waveforms in a wide frequency band and generate focal regions of arbitrary predefined shapes using simple means such as single channel system with one piezoelement will be demonstrated.