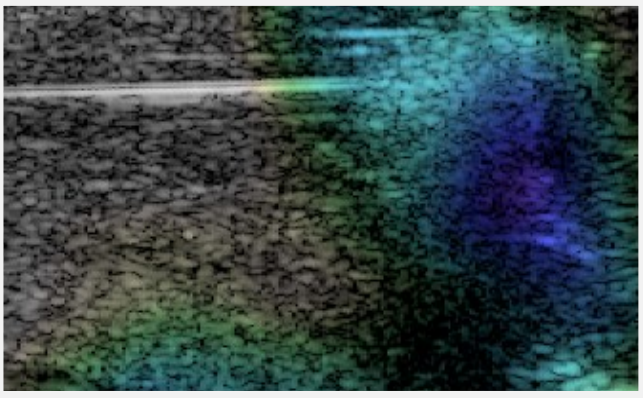
Sound Science:

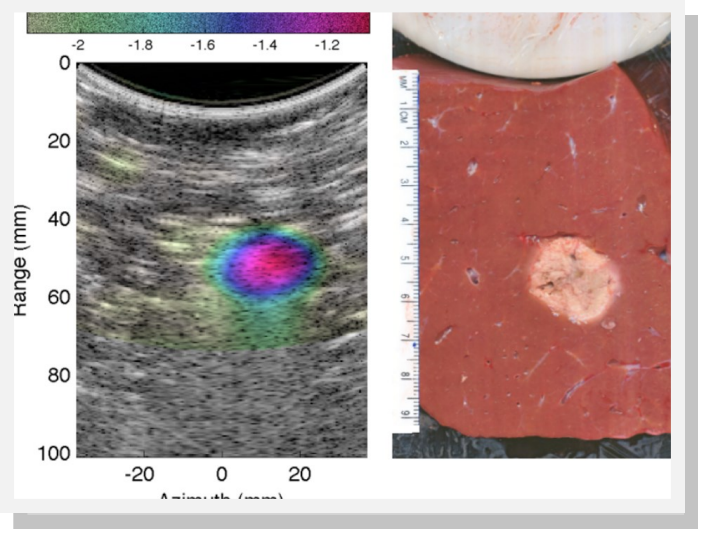
Improving Non-Invasive Cancer Therapy with Ultrasound

T. Douglas Mast, PhD

Liver cancer is a major public health problem, accounting for the largest cancer-related mortality in the world, with only a small fraction of patients eligible for curative resection or transplantation. Thermal ablation, a cancer therapy that uses heat to destroy cancerous tissue, is considered a safer, less invasive alternative to major surgery; however, thermal ablation does not always work. Incomplete treatment, tumor recurrence, and complications caused by collateral tissue damage make thermal ablation an imperfect therapy. Thus, UC's Biomedical Acoustics Lab, led by Dr. T. Douglas Mast, is working on ultrasound imaging to better guide and predict thermal ablation-induced cell death. Ultimately, these improvements could result in fewer complications, reduced tumor recurrence, and improved outcomes for cancer patients.



Echo decorrelation imaging of *in vivo* radiofrequency ablation.



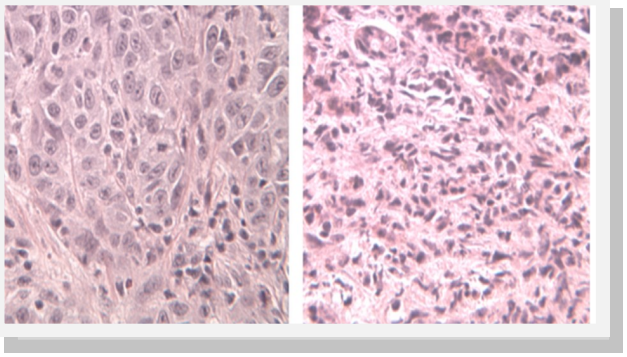
Echo decorrelation imaging from a 4 MHz, 128-element curved linear array with corresponding section of RFA-ablated ex vivo liver.

Echo Decorrelation Imaging

In their current NIH-funded project, Mast and colleagues are exploring ultrasound echo decorrelation imaging, a novel pulse-echo ultrasound method for guidance and control of radiofrequency ablation, high-intensity focused ultrasound surgery, and other thermal therapies. Working with livers from rabbits, the Biomedical Acoustics Lab is using echo decorrelation imagining to map, in millisecond timescales, the changes to tissue as a result of radio frequency ablation (RFA). If successful, the project will enable clinicians to predict—in real-time—thermal ablation-induced cell death, ultimately improving the efficacy and safety of this minimally invasive cancer treatment.

The Biomedical Acoustics Lab

The Biomedical Acoustics Laboratory, led by Dr. Mast, performs research on the therapeutic and diagnostic applications of medical ultrasound including thermal ablation of liver cancer, guidance for minimally invasive therapies, ultrasound-enhanced drug delivery, and noninvasive measurements of tissue mechanical properties.



H&E histologic stains of untreated (left) and ablated (right) VX2 tumor. Severe structural changes associated with thermal ablation are apparent

More about Dr. T. Douglas Mast

Mast, an Associate Professor and Chair of Biomedical Engineering, has been named in Marquis' *Who's Who is Science and Engineering*, *Who's Who in America,* and *Who's Who in Engineering Academia*. His Acoustics research has earned him a number of fellowships, including the F.V. Hunt Fellowship from the Acoustical Society of America. Mast has over 37 journal publications and 8 issued patents to his name, and has earned funding from the National Institutes of Health, the National Science Foundation, and the American Institute of Ultrasound Medicine (EER).

Recent Publications

- Subramanian S, Rudich SM, Karunakaran CP, Rao MB, Mast TD. In vivo thermal ablation monitoring using ultrasound echo decorrelation imaging. *Ultras Med Biol* 2013; submitted.
- Hoerig CL, Serrone JC, Burgess MT, Zuccarello M, Mast TD. Vessel rupture prediction by passive cavitation detection during high-intensity focused ultrasound (HIFU) application in an ex vivo model. *Ultras Med Biol* 2013; submitted.
- Haworth KJ, Mast TD, Radhakrishnan K., Burgess MT, Kopechek JA, Huang S, McPherson DD, Holland CK. Passive cavitation imaging with pulsed ultrasound insonations. *J Acoust Soc* Am 132, 544–553 (2012).