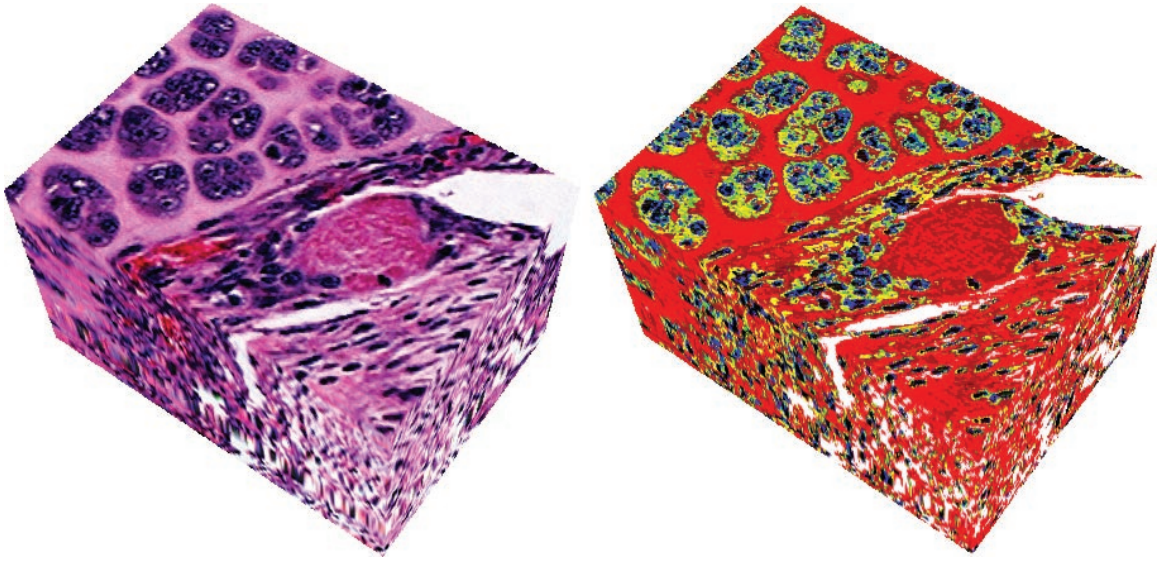
IEEE TRANSACTIONS ON

ULTRASONICS, FERROELECTRICS, AND FREQUENCY CONTROL

A PUBLICATION OF THE IEEE ULTRASONICS, FERROELECTRICS, AND FREQUENCY CONTROL SOCIETY

FEBRUARY 2008 VOLUME 55 NUMBER 2 ITUCER (ISSN 0885-3010)



Access the journal with its multimedia contents online at: http://www.ieee-uffcorg/tr/

Digital Object Identifier 10.1109/TUFFC.2008.637

Computational Three-Dimensional Acoustic Tissue Models From Histologic Sections

Accurate three-dimensional representation of biological tissues may help in the identification of the tissue microstructure responsible for ultrasonic scattering. A novel approach was developed to reconstruct three-dimensional tissue models from adjacent photomicrographs of H&E-stained histologic sections.* The left panel displays a three-dimensional histologic volume (3DHV) reconstructed from a 43-section histologic dataset. The 43 3-μm thick sections were obtained from a mouse mammary tumor (EHS sarcoma). To obtain the 3DHV, the contrast of the sections was first equalized, and then sections were carefully aligned using an automatic non-rigid registration algorithm. Because seven (out of 43) sections were lost during sectioning they were interpolated using third-order Hermite interpolating polynomials. Each section in the reconstructed volume was then thresholded using a 7-level algorithm. The threshold algorithm was engineered under the supervision of a pathologist to guarantee that each level corresponded to a unique tissue microstructure. The right panel displays the resulting volume where seven arbitrary colors were used to represent the seven distinct microstructures. Acoustic impedance values were assigned to each recognized tissue microstructure. The resulting three-dimensional impedance map was then used as a computational phantom for ultrasonic tissue characterization. Both volumes are of size 218 × 156 × 129 μm.

Image courtesy of Jonathan Mamou, Michael L. Oelze, William D. O'Brien, Jr., and James F. Zachary. J. Mamou was with the Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign; he is now with the Frederic L. Lizzi Center for Biomedical Engineering, Riverside Research Institute, New York, NY. M. L. Oelze and W. D. O'Brien, Jr. are with the Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign. J. F. Zachary is with the Department of Veterinary Pathobiology, University of Illinois at Urbana-Champaign. W. D. O'Brien, Jr. and J. F. Zachary are also with the Department of Bioengineering, University of Illinois at Urbana-Champaign.

*J. Mamou, M. L. Oelze and W. D. O'Brien, Jr., "Extended three-dimensional impedance map methods for identifying ultrasonic scattering sites," *The Journal of the Acoustical Society of America*, vol. 123, pp. 1195–1208, 2008.