

3D Segmentation of Curved Needles using Doppler Ultrasound and Vibration**Troy Adebar - stanford.edu****Allison Okamura - stanford.edu**

A method for segmenting the 3D shape of curved needles in solid tissue is described. An actuator attached to the needle outside the tissue vibrates at frequencies between 600 Hz and 6500 Hz, while 3D power Doppler ultrasound imaging is applied to detect the resulting motion of the needle shaft and surrounding tissue. The cross section of the vibrating needle is detected across the series of 2D images produced by a mechanical 3D ultrasound transducer, and the needle shape is reconstructed by fitting a 3D curve to the resulting points. The sensitivity of segmentation accuracy to tissue composition, vibration frequency, and Doppler pulse repetition frequency (PRF) was examined. Comparison with manual segmentation demonstrates that this method results in an average error of 1.09 mm in ex vivo tissue. This segmentation method may be useful in the future for providing feedback on curved needle shape for control of robotic needle steering systems.

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