Robert McGough receives $1.3 million NIH R01 grant to improve algorithms for ultrasound

Robert J. McGough, an associate professor of electrical and computer engineering, has received a $1.3 million NIH R01 grant to extend the capabilities of diagnostic and therapeutic ultrasound.

“Diagnostic ultrasound uses high frequency, low intensity sound waves to noninvasively see inside the human body,” McGough said. “This real-time imaging modality is portable, safe, and cost-effective. It provides helpful images during pregnancy and examinations of the heart, blood vessels, thyroid, breast, prostate, liver, and kidney.

“In contrast,” he continued, “therapeutic ultrasound delivers high frequency sound waves at a much higher intensity to treat or destroy diseased tissues.”

Application of therapeutic ultrasound include noninvasive methods for cancer therapy, targeted drug delivery, and for treating essential tremor.

"None of the software currently used for simulations of medical ultrasound is capable of effectively modeling the very large peak pressures (50+ MPa) that are required for histotripsy,” he said.

McGough said his research group is also actively creating new ultrasound-based approaches for imaging with shear waves.

“Shear waves provide a unique approach for noninvasively and quantitatively ‘palpating’ suspicious lesions that are ‘stiffer’ than background tissues,” he explained. “Current computational approaches used for modeling shear waves in medical ultrasound have significant limitations. Methods for estimating shear wave parameters also have serious
deficiencies. We’ll be working to find solutions to both of these problems.”

McGough’s primary research interests span multiple applications of therapeutic and diagnostic ultrasound. His research group developed the popular FOCUS software package for rapidly simulating biomedical ultrasound, based on the fast ultrasound simulation algorithms he created with his graduate students. His present research projects include shear wave elasticity imaging, nonlinear modeling of shock waves for histotripsy, and fractional calculus modeling of ultrasound attenuation and dispersion. He is a fellow of the Acoustical Society of America.

He received electrical engineering degrees from the University of Michigan (PhD), the University of Illinois (MS) and Vanderbilt University (BS in electrical engineering and physics).

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