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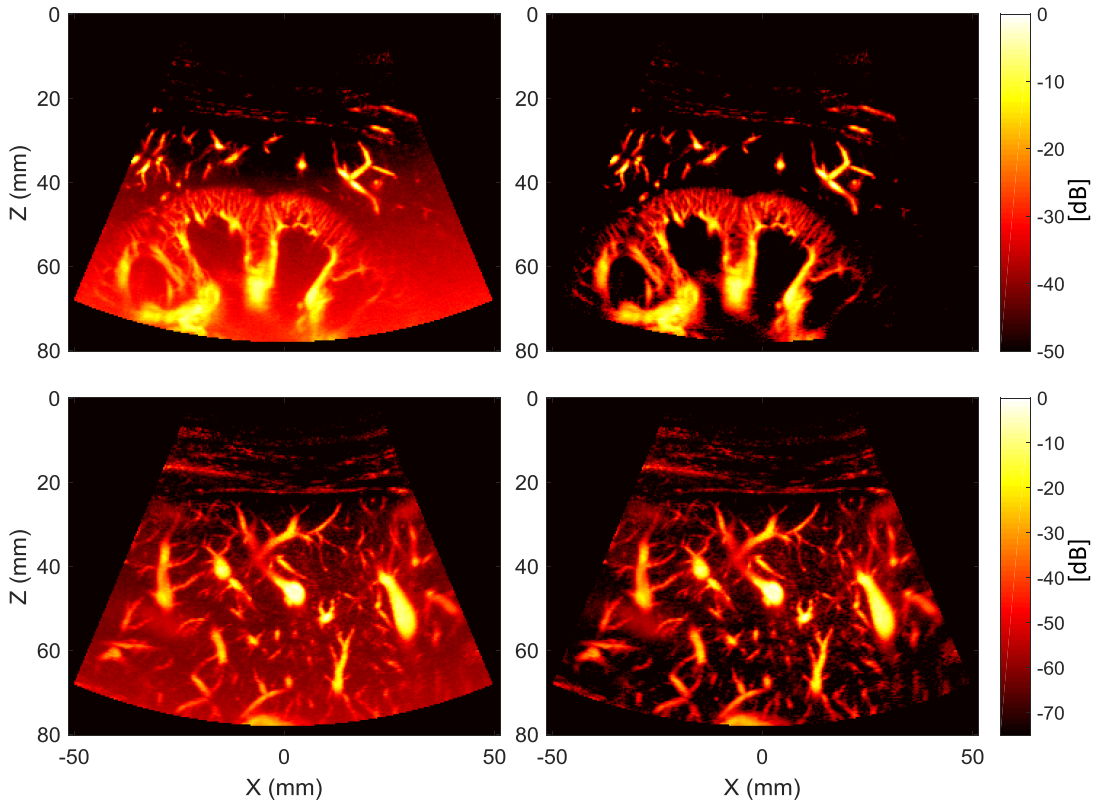

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Debiasing-Based Noise Suppression for Ultrafast Ultrasound Microvessel Imaging

Ultrasound microvessel imaging (UMI) based on the combination of singular value decomposition (SVD) clutter filtering and ultrafast ultrasound imaging has recently demonstrated substantially improved Doppler sensitivity, especially to small (< 0.7 mm diameter) vessels that are invisible to conventional Doppler imaging performed typically at about 4.5 MHz. This work proposes a noise suppression method based on noise debiasing that promises to facilitate the real-time implementation of enhanced-quality UMI with background noise suppressed. The proposed method experimentally measures the noise-induced bias by collecting noise signal using the identical imaging sequence as conventional UMI, but with the ultrasound probing wave turned off. The estimated bias can then be subtracted from the original power Doppler image to obtain effective noise suppression. The cover images show the UMI of *in vivo* human kidney and *in vivo* human liver before (left column) and after (right column) noise suppression demonstrating an improved vasculature visualization. The proposed noise suppression method has negligible computational cost and can be combined with a previously proposed accelerated singular value decomposition clutter filtering technique to provide real-time UMI for various clinical applications, such as kidney, liver, inflammatory bowel diseases, and tumor evaluations.

Images are courtesy of Chengwu Huang, Pengfei Song, Ping Gong, Joshua D. Trzasko, Armando Manduca, and Shigao Chen. C. Huang, P. Gong, J. D. Trzasko, and S. Chen are with the Department of Radiology, Mayo Clinic College of Medicine and Science, Rochester, MN 55905, USA. P. Song is with the Department of Radiology, Mayo Clinic College of Medicine and Science, Rochester, MN 55905, USA, also with the Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL 61801 USA, and also with Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign, Urbana, IL 61801 USA. A. Manduca is with the Department of Physiology and Biomedical Engineering, Mayo Clinic College of Medicine and Science, Rochester, MN 55905 USA.