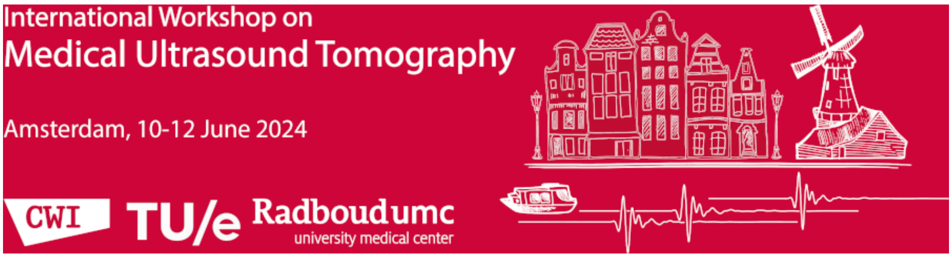

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Multichannel end-to-end AI-based super-resolution

Monday, June 10, 2024 4:35 PM (15 minutes)

Super-resolution ultrasound imaging represents a significant advancement in the field of medical imaging, particularly through the application of ultrasound localization microscopy (ULM). However, ULM's requires sparse microbubble distributions, which in turn, imposes prolonged acquisition times to adequately image the full microvasculature. We introduce a novel super-resolution methodology that overcomes traditional ULM limitations by employing a direct deconvolution technique on all radiofrequency (RF) channels obtained by single plane-wave imaging. We leverage a deep learning physics-based approach, which integrates Stolt's FK migration beamforming algorithm into the network architecture. Focusing on low-frequency ultrasound (1.7 MHz), our research targets deep imaging capabilities (up to 10 cm) within a dense cloud of monodisperse microbubbles, accommodating up to 1000 microbubbles within the 2D measurement volume. Our approach utilizes a simulation framework that encompasses a broad spectrum of acoustic pressures (5-250 kPa) to accurately model the complex, nonlinear response of resonant, lipid-coated microbubbles. Previously, published work uses single-channel deconvolution with a 1D dilated convolutional network. The core innovation of this study lies in replacing this 1D network by various 2D architectures operating on all RF lines simultaneously in order to exploit the correlation among transducer elements and allowing end-to-end learning of microbubble location. We expect this approach to reduce detection uncertainty and to more effectively handle high bubble concentrations, leading to better localization in more realistic scenarios.

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