International Workshop on
Medical Ultrasound Tomography
London, 27-29 June 2022

Contribution ID: **5**   Type: **not specified**

Multi-perspective bistatic 2-D and 3-D ultrasound acquisitions and strain imaging of abdominal aortas

Wednesday, June 29, 2022 11:20 AM (20 minutes)

Ultrasound imaging is a safe and accessible modality to visualize the abdomen. It is frequently used to assess the geometry of the abdominal aorta, which can provide clinicians with patient-specific information of aortic aneurysms. The anisotropy in resolution and contrast, caused by the limited aperture size and refraction, degrade image quality and restrict the estimation and precision of local wall deformation and mechanical properties. Expanding the imaging aperture with an additional transducer can improve the lateral resolution and extent the angular coverage of the vessel wall. This study demonstrates a dual-transducer system for aortic strain imaging that combines multi-perspective ultrasound transmits with a simultaneous receive (bistatic imaging).

The acquisition sequence consists of fast interleaved transmits of diverging waves that can be received by both transducers. For 3-D imaging this was realized with the use of sparse random apertures on two matrix arrays. After registration, multi-perspective ultrasound images were fused and 2-D axial displacement fields were compounded, discarding all lateral tracking data. Strain estimates were compared for ex vivo porcine aortas in a mock loop of the abdomen and systemic circulation. In 3-D, aortic wall contrast was measured and spatial resolution was quantified in a phantom containing point sources, normal background scattering, and different contrast lesions.

Compounding of multi-perspective axial displacements reduced motion tracking errors with a factor 10 compared to conventional tracking of focused scanline images. Consequently, strain precision and resolution increased, leading to more homogeneous circumferential strain patterns and enabling measurements of local radial strain at high resolution wall segments which can be further extended with the inclusion of trans-probe signals. In 3-D, coherent fusion of multi-perspective signals reduced the volumetric speckle size by 66% at a depth of 8 cm and wall-lumen contrast of the aorta increased by 4.5 dB. Future work includes multi-perspective strain estimations in 3-D, in vivo measurements, and mechanical characterization of patient-specific local wall properties of the abdominal aorta.

Preferred Contribution Type

Presentation

Author: Mr DE HOOP, Hein (Eindhoven University of Technology)

Co-authors: VAN HAL, Vera (Eindhoven University of Technology); Ms VERMEULEN, Marieke (Eindhoven University of Technology); Dr SCHWAB, Hans-Martin (Eindhoven University of Technology); Dr RICHARD, Lopata (Eindhoven University of Technology)

Presenter: Mr DE HOOP, Hein (Eindhoven University of Technology)