Tissue Harmonic Synthetic Aperture Imaging - DTU Orbit (21/12/2018)

Tissue Harmonic Synthetic Aperture Imaging
The main purpose of this PhD project is to develop an ultrasonic method for tissue harmonic synthetic aperture imaging. The motivation is to advance the field of synthetic aperture imaging in ultrasound, which has shown great potentials in the clinic. Suggestions for synthetic aperture tissue harmonic techniques have been made, but none of these methods have so far been applicable for in-vivo imaging. The basis of this project is a synthetic aperture technique known as synthetic aperture sequential beamforming (SASB). The technique utilizes a two step beamforming approach to drastically reduce system complexity compared to conventional synthetic aperture techniques. In this project, SASB is sought combined with a pulse inversion technique for 2nd harmonic tissue harmonic imaging. The advantages in tissue harmonic imaging (THI) are expected to further improve the image quality of SASB. The first part of the scientific contribution investigates an implementation of pulse inversion for THI on the experimental ultrasound system SARUS. The technique is initially implemented for linear array transducers and then expanded for convex array transducers. The technique is evaluated based on spatial resolution. The concept of harmonic energy leakage is investigated and minimized using harmonic matched filters. The second part of the study demonstrates that a combination of SASB with THI is feasible for a linear array transducer on SARUS. The method is expanded for convex array transducer and implemented on a commercial ultrasound system. An optimization study of the scan settings for SASB with THI is performed. In the final part, a clinical investigation of the clinical relevance of SASB with THI is performed. The clinical relevance is determined by the image quality, sensitivity and specificity of the technique. Clinical scans were conducted in collaboration with medical professionals at Copenhagen University. In a series of double blinded trials, image quality and recognition of pathology using SASB with THI was compared with conventional THI. The results of the clinical trial documented, that SASB with THI provided as good image quality and specificity as conventional THI and provided 6% better sensitivity compared with conventional THI.

**General information**
State: Published
Organisations: Department of Electrical Engineering, Biomedical Engineering, Center for Fast Ultrasound Imaging
Contributors: Rasmussen, J., Jensen, J. A.
Number of pages: 220
Publication date: 2013

**Publication information**
Publisher: Technical University of Denmark, Department of Electrical Engineering
Original language: English
Electronic versions: dissertation_jr.pdf
Research output: Research › Ph.D. thesis – Annual report year: 2014