Automatic Ultrasound Scanning - DTU Orbit (28/12/2018)

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Medical ultrasound has been a widely used imaging modality in healthcare platforms for examination, diagnostic purposes, and for real-time guidance during surgery. However, despite the recent advances, medical ultrasound remains the most operator-dependent imaging modality, as it heavily relies on the user adjustments on the scanner interface to optimize the scan settings. This explains the huge interest in the subject of this PhD project entitled "AUTOMATIC ULTRASOUND SCANNING". The key goals of the project have been to develop automated techniques to minimize the unnecessary settings on the scanners, and to improve the computer-aided diagnosis (CAD) in ultrasound by introducing new quantitative measures. Thus, four major issues concerning automation of the medical ultrasound are addressed in this PhD project. They touch upon gain adjustments in ultrasound, automatic synthetic aperture image quality optimization, automated vessel segmentation in ultrasound, and lack of CAD in point-of-care lung ultrasound. The goals of this PhD are achieved for each of the subjects. First, a new automated time gain compensation technique is proposed that compensates for gains of the scans in 2-D. The proposed model outperforms the current 1-D curve compensation in commercial scanners, as the 2-D topology of the scans are not fully integrated in those techniques. Second, an automated generic technique is proposed for optimization of synthetic aperture image quality. This generic model can be used for any imaging regime using any transducer geometry. Third, a hybrid vessel segmentation technique is proposed that combines both vector velocity estimates (VFI) and B-mode images. The technique enables the wall-to-wall visualization of VFI, as well as provides a firm ground for quantitative quantification of VFI in state-of-the-art US scanners. Finally, a new technique is introduced to detect disease-related reverberation artifacts in lung ultrasound, thereby exploiting the full potential of this imaging modality.

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