University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Master of Applied Science

of

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BSc (United States Coast Guard Academy, 2013)

"Efficient Two-Pass Beamforming Applied to Ultrasound Imaging"

Department of Electrical and Computer Engineering

Monday, May 1, 2017
2:00 P.M.
Engineering Office Wing
Room 230

Supervisory Committee:
Dr. Daler Rakhmatov, Department of Electrical and Computer Engineering, University of Victoria (Supervisor)
Dr. Mihai Sima, Department of Electrical and Computer Engineering, UVic (Member)

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Chair of Oral Examination:
Dr. Raad Nashmi, Department of Biology, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

In the past decade, the application of adaptive beamforming methods to medical ultrasound imaging has become a field of increased interest, due to their ability to achieve superior ultrasound image quality. Such enhancements, however, come at a high computational cost. This thesis attempts to address the following simple question: Can we maintain a superior image quality while reducing the computational cost of adaptive beamforming? Our goal is to effectively combine low-complexity nonadaptive beamforming, such as the Delay-and-Sum (DAS) technique, with high-complexity adaptive beamforming, such as the Minimum variance Distortionless Response (MVDR) technique, implemented using the Generalized Sidelobe Canceller (GSC), to obtain high-quality images at low computational cost. We propose a simple two-pass beamforming scheme for that purpose. During the first pass, our scheme processes buffered input vectors using the inexpensive DAS method and computes the corresponding envelope. Based on that envelope information, selected outputs may be recomputed during the second pass (to improve beamforming performance) using the expensive GSC beamforming method. The purpose of the first pass is to identify which nonadaptively beamformed outputs can be spared from a heavy computational load of adaptive beamforming taking place in the second pass. We have evaluated our scheme using simulated ultrasound images of a 12-point phantom and a point-scatterer-cyst phantom, achieving substantial threshold-dependent computational savings without significant degradation in image resolution and contrast, compared to pure GSC beamforming.