University of Victoria | Graduate Studies

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

of

RAMIN ZAEIM

M.Sc (Science and Research Azad University 2010)
B.Sc (Science and Research Azad University 2006)

"Direction of Arrival Estimation Technique for Narrow-Band Signals Based on Spatial Fast Fourier Transform"

Department of Mechanical Engineering

Monday, August 13, 2018
10:00am
Electrical and Computer Science
Room 468

Supervisory Committee:
Dr. Panajotis Agathoklis, Department of Electrical Engineering, University of Victoria (Supervisor)
Dr. Dale Shpak, Department of Electrical Engineering, UVic (Member)
Dr. Yang Shi, Department of Engineering, UVic (Outside Member)

External Examiner:
Dr. Daler Rakhmatov, Department of Electrical and Computer Engineering, UVic

Chair of Oral Examination:
Dr. Kui Wu, Department of Computer Science

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

This work deals with the further development of a method for Direction of Arrival (DOA) estimation based on the Fast Fourier Transform (FFT) of the sensor array output. In the existing FFT-based algorithm, relatively high SNR is considered and it is supposed that a large number of sensors are available.

In this study an overview of some of the most commonly used DOA estimation techniques will be presented. Then the performance of the FFT method will be analyzed and compared with the performance of existing techniques. Two main objectives will be studied, 1- the reduction of the number of sensors and 2-the performance of the FFT based technique in the presence of noise.

Experimental simulations will be presented to illustrate that in absence of noise, the proposed method is very fast and using just one snapshot is sufficient to accurately estimate DOAs. Also, in presence of noise, the method is still relatively fast and using a few number of snapshots, it can accurately estimate DOAs.

The above mentioned properties are the result of taking an average of the peaks of the FFTs, $\boldsymbol{X}_n(k)$, obtained from a sequence of N_s snapshots. With N_s sufficiently large, the average over N_s snapshots approaches expected value. Also, the conditions that should be satisfied to avoid overlapping of main-lobes, and thus loosing the DOA of some signals, in the FFT spectrum are examined.

This study further analyzes the performance of the proposed method as well as two other commonly used algorithms, MUSIC and conventional beamformer. An extensive simulation was conducted and different features of the spatial FFT technique, such as accuracy, resolution, sensitivity to noise, effect of multiple snapshots and the number of sensors were evaluated and compared with those of existing techniques. The simulations indicate that in most aspects the proposed spatial FFT algorithm outperforms the other techniques.