



University
of Victoria

Graduate Studies

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

of

AHMED ELGAREWI

BSc (University of Tripoli, 2013)

“Analysis of Algorithms for Filter Bank Design Optimization”

Department of Electrical and Computer Engineering

Friday August 30, 2019

10:00 A.M.

Engineering Computer Science Building
Room 467

Supervisory Committee:

Dr. Pan Agathoklis, Department of Electrical and Computer Engineering, University of Victoria
(Supervisor)

Dr. Wu-Sheng Lu, Department of Electrical and Computer Engineering, UVic (Member)

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Dr. Keivan Ahmadi, Department of Mechanical Engineering, UVic

Chair of Oral Examination:

Dr. Helena Kadlec, Department of Psychology, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

This thesis deals with design algorithms for filter banks based on optimization. The design specifications consist of the perfect reconstruction and frequency response specifications for FIR analysis and synthesis filters. The perfect reconstruction conditions are formulated as a set of linear equations with respect to the analysis filters' coefficients and the synthesis filters' coefficients. Five design algorithms are presented. The first three are based on an unconstrained optimization of performance indices, which include the perfect reconstruction error and the error in the frequency specifications. The last two algorithms are formulated as constrained optimization problems with the perfect reconstruction error as the performance index and the frequency specifications as constraints. The performance of the five algorithms is evaluated and compared using six examples; these examples include uniform filter bank, compatible non-uniform filter bank and incompatible nonuniform filter bank designs. The evaluation criteria are based on distortion and aliasing errors, the magnitude response characteristics of analysis and synthesis filters, the computation time required for the optimization, and the convergence of the performance index with respect to the number of iterations. The results show that the five algorithms can achieve almost perfect reconstruction and can meet the frequency response specifications at an acceptable level. In the case of incompatible non-uniform filter banks, the algorithms have challenges to achieve almost perfect reconstruction.