University of Victoria | Graduate Studies

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

of

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M.Eng (University of Sheffield, 2012)

"An Improved Incremental/Decremental Delaunay Mesh-Generation Strategy for Image Representation"

Department of Electrical and Computer Engineering

Tuesday, December 13, 2016
1:00 P.M.
Engineering Office Wing
Room 430

Supervisory Committee:
Dr. Michael Adams, Department of Electrical and Computer Engineering, University of Victoria (Supervisor)
Dr. Pan Agathoklis, Department of Electrical and Computer Engineering, UVic (Member)

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Dr. Robin Hicks, Department of Chemistry, UVic

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Abstract

Two highly effective content-adaptive methods for generating Delaunay mesh models of images, known as IID1 and IID2, are proposed. The methods repeatedly alternate between mesh simplification and refinement, based on the incremental/decremental mesh-generation framework of Adams, which has several free parameters. The effect of different choices of the framework's free parameters is studied, and the results are used to derive two mesh-generation methods that differ in computational complexity. The higher complexity IID2 method generates mesh models of superior reconstruction quality, while the lower complexity IID1 method trades mesh quality in return for a decrease in computational cost. Some of the contributions of our work include the recommendation of a better choice for the growth-schedule parameter of the framework, as well as the use of Floyd-Steinberg error diffusion for the initial-mesh selection.

As part of our work, we evaluated the performance of the proposed methods using a data set of 50 images varying in type (e.g., photographic, computer generated, and medical), size and bit depth with multiple target mesh densities ranging from 0.125% to 4%. The experimental results show that our proposed methods perform extremely well, yielding high-quality image approximations in terms of peak-signal-to-noise ratio (PSNR) and subjective visual quality, at an equivalent or lower computational cost compared to other well known approaches such as the ID1, ID2, and IDDT methods of Adams, and the greedy point removal (GPR) scheme of Demaret and Iske. More specifically, the IID2 method outperforms the GPR scheme in terms of mesh quality by 0.12{1.2 dB with a 25{90% decrease in computational cost. Furthermore, the IID2 method yields meshes of similar quality to the ID2 method at a computational cost that is lower by 1{39%. The IID1 method provides improvements in mesh quality in 93% of the test cases by margins of 0.06{1.67 dB compared to the IDDT scheme, while having a similar complexity. Moreover, reductions in execution time of 4{57% are achieved compared to the ID1 method in 94% of the test cases.