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 (University of Electronic Science and Technology of China, 2014)

"A Novel Fully Progressive Lossy-to-Lossless Coder for Arbitrarily-Connected Triangle-Mesh Models of Images and Other Bivariate Functions"

Department of Electrical and Computer Engineering

Thursday, August 9, 2018
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Engineering Office Wing
Room 430

Supervisory Committee:
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Dr. Pan Agathoklis, Department of Electrical and Computer Engineering, UVic (Member)

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Abstract

A new progressive lossy-to-lossless coding method for arbitrarily-connected triangle mesh models of bivariate functions is proposed. The algorithm employs a novel representation of a mesh dataset called a bivariate-function description (BFD) tree, and codes the tree in an efficient manner. The proposed coder yields a particularly compact description of the mesh connectivity by only coding the constrained edges that are not locally preferred Delaunay (locally PD). Experimental results show our method to be vastly superior to previously-proposed coding frameworks for both lossless and progressive coding performance. For lossless coding performance, the proposed method produces the coded bitstreams that are 27.3% and 68.1% smaller than those generated by the Edgebreaker and Wavemesh methods, respectively. The progressive coding performance is measured in terms of the PSNR of function reconstructions generated from the meshes decoded at intermediate stages. The experimental results show that the function approximations obtained with the proposed approach are vastly superior to those yielded with the image tree (IT) method, the scattered data coding (SDC) method, the average-difference image tree (ADIT) method, and the Wavemesh method with an average improvement of 4.70 dB, 10.06 dB, 2.92 dB, and 10.19 dB in PSNR, respectively. The proposed coding approach can also be combined with a mesh generator to form a highly effective mesh-based image coding system, which is evaluated by comparing to the popular JPEG 2000 codec for images that are nearly piecewise smooth. The images are compressed with the mesh-based image coder and the JPEG 2000 codec at the fixed compression rates and the quality of the resulting reconstructions are measured in terms of PSNR. The images obtained with our method are shown to have a better quality than those produced by the JPEG 2000 codec, with an average improvement of 3.46 dB.