CITY UNIVERSITY OF HONG KONG
香港城市大學

Fast Mode Decision and Rate Control for H.264/AVC and SVC extension
视频编码的快速算法和码率控制

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by

HU Sudeng
胡速登

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Abstract

In this thesis, a Fast Inter-Mode Decision algorithm is proposed for H.264/AVC and Rate Control(RC) algorithms are proposed for temporal and spatial layer Scalable Video Coding (SVC) respectively.

Firstly, a new fast mode decision (FMD) algorithm is proposed for the state-of-the-art video coding standard H.264/AVC. Based on Rate-Distortion (RD) cost characteristics, all inter modes are classified into two groups, one is Skip mode (including both Skip and Direct modes) and all the other inter modes are called non-Skip modes. In order to select the best mode for coding a Macroblock (MB), minimum RD costs of these two mode groups are predicted respectively. Then for Skip mode, an early Skip mode detection scheme is proposed; for non-Skip modes, a three-stage scheme is developed to speed up the mode decision process. Experimental results demonstrate that the proposed algorithm has good robustness in coding efficiency with different Quantization parameters (Qp) and various video sequences and is able to achieve about 54% time saving on average while with negligible degradation in Peak-Signal-to-Noise-Ratio (PSNR) and acceptable increase in bit rate.

Secondly, for temporal scalable video coding, a novel frame-level RC algorithm is presented in this thesis. By introducing a linear quality dependency model, the quality dependency relation between a coding frame and its references is investigated for the hierarchical B-picture prediction structure. Linear Rate-Quantization (R-Q) and Distortion-Quantization (D-Q) models are introduced based on different characteristics of temporal layers. According to the proposed quality dependency model and R-Q and D-Q models for each temporal layer, an adaptive weighting factor is derived to

allocate bits efficiently among temporal layers. Experimental results on not only traditional QCIF/CIF but also Standard Definition (SD) and High Definition (HD) sequences demonstrate that the proposed algorithm achieves excellent coding efficiency as compared to other benchmark RC schemes.

Thirdly, for spatial layer of Scalable Video Coding, a novel rate control algorithm is presented in this thesis. A new best initial Qp model is proposed based on the power R-Q model. By applying the proposed sequence complexity measurement, the proposed model can provide proper initial Qp before encoding. Then the relationship between the best initial Qps of different layers is investigated and determination of the best initial for multiple Qps layer is introduced. Meanwhile by introducing a two stage RC scheme, a novel frame complexity estimation method is proposed. The dependency of the parameters in the RQ model is investigated to improve the model accuracy. The experimental results demonstrate that the proposed RC scheme and best initial Qp perform excellent coding efficiency and accurate bit achievement.

Contents

List of Abbreviations

R-D	Rate-Distortion
RC	Rate Control
MV	Motion Vector
FMD	Fast Mode Decision
SVC	Scalable Video Coding
HBP	Hierarchical B-Picture
MAD	Mean Absolute Difference
Qp	Quantization Paramter
RDO	Rate Distortion Optimization
GOP	Group of Picture
BR	Bit Rate
PSNR	Peak Signal-to-Noise Ratio

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