Fast Multi-Rate Encoding for Adaptive HTTP Streaming

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HTTP adaptive streaming (HAS) provides an increasing number of representations of the same content in different qualities (*i.e.*, bit-rates) and resolutions [1]. Encoding of one video segment at different representations is a challenging task in terms of encoding time-complexity. *High Efficiency Video Coding* (HEVC) uses sophisticated tools like Coding Tree Unit (CTU) structure to achieve efficiency at the cost of encoding time-complexity. The correlation between co-located CTUs at different representations can be exploited to reduce this complexity. In this paper, information of both the highest and the lowest quality representations are used to limit search process for each CTU in HEVC. Our proposed method first encodes the highest quality representation. Then, information of CTUs are used to encode the lowest quality representation by limiting maximum depth of CTUs to maximum depth of co-located CTUs in the highest-quality representation. Finally, information from both the highest and the lowest quality representations are used to predict features of intermediate quality representations. In particular, the CU structure and the selected reference frame information are used in this paper. For CU structure, the search range is bounded between the depth values of co-located CTUs in the lowest and the highest representations. For reference frame, if both co-located CTUs in the lowest and the highest representations select the same reference frame, that reference frame is used for the intermediate representation and further searches are skipped. The proposed method only introduces a delay of two CTUs if parallel encoding is used. The flowchart of the proposed method is shown in Figure 1. Experimental results show significant reduction in time-complexity over the reference software (38%) and the state-of-the-art [2] (10%) while quality degradation is negligible.

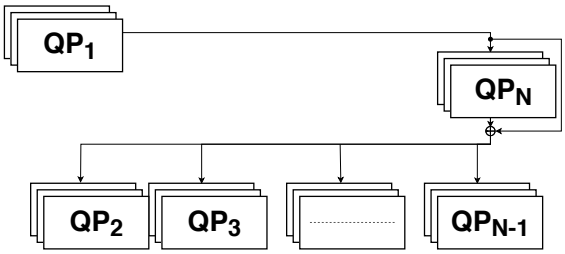

Figure 1: Flowchart of the proposed method.

[1] A. Bentaleb, B. Taani, A. C. Begen, C. Timmerer, and R. Zimmermann, "A Survey on Bitrate Adaptation Schemes for Streaming Media Over HTTP," *IEEE Communications Surveys Tutorials*, vol. 21, no. 1, pp. 562–585, Firstquarter 2019.

[2] D. Schroeder, P. Rehm, and E. Steinbach, "Block structure reuse for multi-rate high efficiency video coding," in *2015 IEEE International Conference on Image Processing (ICIP)*, Sep. 2015, pp. 3972–3976.

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