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Gop Size Effect on VVC Encoder Performance with MRF Varation

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Abstract— **The exponential growth of multimedia content and applications underscores the ongoing challenge of developing advanced video coding standards that not only enhance compression rates but also incorporate essential features while addressing increasing complexity in computational processing. Among these standards, the Versatile Video Coding (VVC) standard stands out for its superior efficiency compared to its predecessors. As one of the key parameters in video compression algorithms, the size of Group of Pictures (GOP) determines the frames interdependency in the encoded video. The GOP size significantly influences the performance of a Video Coding Standard (VVC) encoder, particularly in conjunction with Multiple Reference Frame (MRF) variation. Adjusting the GOP size can have a profound impact on compression efficiency and visual quality for video coding. In this study, we investigate the effect of varying MRF configurations and GOP sizes on the performance of VVC encoder. Furthermore, we advance the notion that achieving diverse MRF configurations is feasible through strategic adjustments to the number of reference frame within each reference list. In this paper, we present statistical results showing the impact of different Quantization Parameters (QPs) and GOP size on encoder performance for each configuration. Based on our results, varying GOP size with MRF configurations has a significant positive impact on encoder performance as measured by bitrate and execution time for several values of QP without affecting the quality of the reconstructed video and the resulted bitrate.**

Keywords—Video compressing, VVC encoder, Inter prediction, GOP size, MRF, QP

I. INTRODUCTION

The Versatile Video Coding (VVC) standard represents a cutting edge improvement in video compression technologies over the widely used High Efficiency Video Coding (HEVC) [1]. VVC is the latest video compression standard, which offers significant performance improvements over its predecessors like H.264 [2] and H.265 [3]. VVC standard was developed collaboratively by the Joint Video Experts Team (JVET) and the Moving Picture Experts Group (MPEG) in 2020. It aims to revolutionize video streaming and multimedia applications [4]. In fact, the share of video in global data traffic is now about 80% and is continuing to grow as broadband Internet services gain reach and speed [5]. Furthermore, 4K TV sets are steadily on the rise, and these higher resolution TVs require better video content to reach their full potential. While practically all 4k TVs come equipped with HEVC decoders to play back 4k video, the data rates necessary to deliver that content are still rather high, stretching the capacity of broadband connections. As a result, VVC is designed to provide even better compression than HEVC.

The VVC standard uses the same hybrid coding frame work as HEVC, but has several highly adaptive and sophisticated coding tools. The VVC generally uses a multi-type tree structure (i.e., quadripartite, binary, or ternary tree) to split images into squares or non-squares. The blocks serve as fundamental units for signaling prediction information, which are subsequently utilized in both intra-prediction and inter-prediction processes [6]. Following this, they undergo transformation and quantization using switchable bases for residual coding. Subsequently, a series of in-loop filters are applied to enhance subjective quality, encompassing deblocking, sample-adjustable offset, and adaptive loop filtering [7]. In a video signal, there is high temporal redundancy among sequential images; which makes inter prediction a critical part of the video compression capability and a key part of hybrid video coding. The VVC software develops many novel coding tools to enhance the inter prediction module. The VVC structure is applied on GOP where its size is an input parameter into the encoder configuration. The GOP size affects the overall performance of the VVC encoder. The number of frames included in each GOP can be controlled to balance the trade-off between compression efficiency and decoding delay. It is crucial to understand how GOP size affects video encoder performance in order to optimize workflows and achieve a desired balance between encoding efficiency and latency. In fact, we will examine the impact of two GOP size on video quality, bit rate, and encoding time as well as the trade-off between encoding efficiency and computational complexity. In this experiment, a variety of video sequences are tested for two configurations where GOP size equal 16 and 32 for two different MRF combinations. The remainder of this article is organized as follows. Section II details the VVC inter prediction module. Where section III proposes the structure of the used configurations. Subsequently, results are provided to evaluate and compare all proposed configurations in section IV. Finally, a conclusion is presented in section V.