Adaptive bilateral matching for decoder-side motion vector refinement in video coding

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Agenda

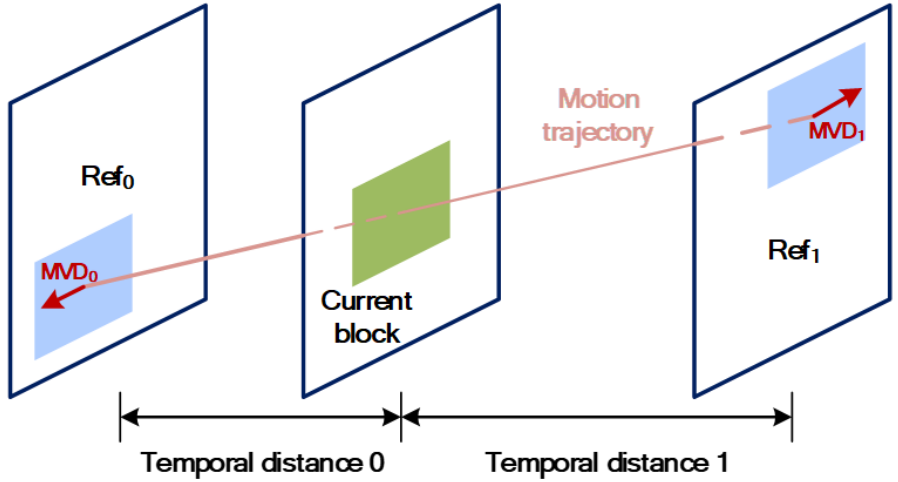
- Introduction
- Overview of DMVR in VVC and ECM
- Proposed adaptive bilateral matching for DMVR
- Experimental results

Introduction

- Versatile Video Coding (VVC)
  - Finalized in July 2020
  - Around 38% BD-rate improvement over HEVC
- Enhanced Compression Model (ECM)
  - Established in April 2021 for exploration experiment on enhanced compression beyond VVC capability
  - Around 15% BD-rate improvement over VVC
- Research of interest: Decoder-side Motion Vector Refinement (DMVR)
  - Refine bi-prediction motion by bilateral matching
  - Finer motion granularity by subblock-based refinement
  - No signaling overhead
- Proposed: adaptive bilateral matching
  - Signal side information for the bilateral matching process
  - Adopted in ECM-3.0

Overview of DMVR in VVC

- Applied for bi-prediction merge candidate
- Subblock based (16x16)
- Bilateral matching
  - Symmetrical motion vector differences
  - Interpolation: bilinear
  - Cost criterion: Sum of Absolute Differences
  - 5x5 search window for integer pel search
  - Parametric error surface model based fractional pel derivation
- Refined MVs are stored for temporal motion vector prediction



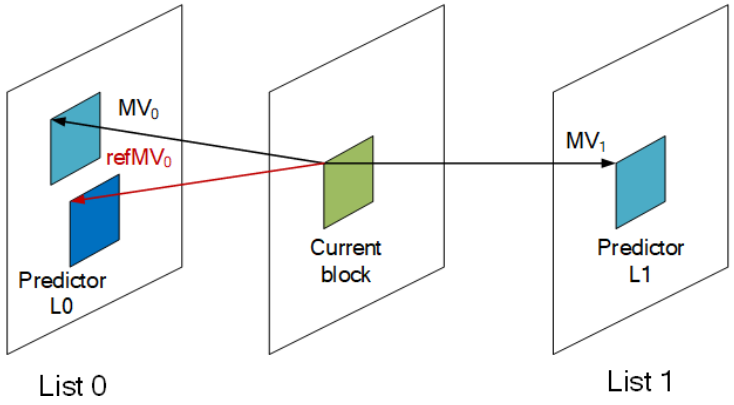
Bilateral matching with symmetrical MVD

Overview of DMVR in ECM-2.0

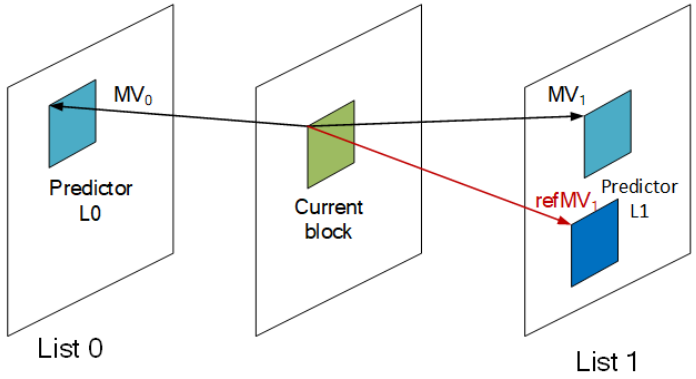
- Hierarchical refinement
  - Coding block level (bilateral matching)
  - 16x16 subblock level (bilateral matching)
  - 8x8 subblock level (BDOF based)
- Extended search area: 17x17
- Adaptive search range
- Store refined MVs for spatial MVP

Proposed adaptive bilateral matching for DMVR

- Motivation: allowing encoder to adaptively select a directional bilateral matching process
  - Symmetrical MVD
  - List 0 MVD
  - List 1 MVD
- Design:
  - Regular merge mode
    - Use symmetrical MVD
  - Two new merge modes
    - bm_merge_mode1: only List 0 MVD at coding block level
    - bm_merge_mode2: only List 1 MVD at coding block level
  - Share same merge list with bi-prediction candidates
  - Signal flags to differentiate among the two new merge modes and regular merge mode



Bilateral matching mode 1



Bilateral matching mode 2

Experimental results

Test 1: VTM-11.0 as code base and anchor, random-access common test condition of VTM

Coding performance of the hierarchical DMVR

	Y	U	V	EncT	DecT
Class A1	-1.58%	-1.46%	-1.54%	113%	189%
Class A2	-2.79%	-2.50%	-2.52%	115%	242%
Class B	-1.35%	-1.11%	-1.23%	112%	204%
Class C	-1.31%	-1.09%	-1.29%	112%	197%
Class E					
Overall	-1.68%	-1.45%	-1.57%	113%	206%
Class D	-1.44%	-1.11%	-1.23%	111%	207%

Note: DMVR off in VTM provides ~ 0.8%

Coding performance of the proposed method

	Y	U	V	EncT	DecT
Class A1	-2.74%	-2.28%	-2.52%	125%	160%
Class A2	-4.28%	-3.72%	-3.75%	122%	184%
Class B	-2.23%	-1.88%	-2.01%	124%	165%
Class C	-2.38%	-2.08%	-2.35%	124%	164%
Class E					
Overall	-2.78%	-2.38%	-2.55%	124%	168%
Class D	-2.59%	-2.30%	-2.33%	123%	171%

Experimental results

Test 2: ECM-2.0 as code base and anchor, random-access common test condition of ECM

	Y	U	V	EncT	DecT
Class A1	-0.26%	-0.15%	-0.26%	103%	96%
Class A2	-0.27%	-0.18%	-0.16%	103%	94%
Class B	-0.21%	-0.13%	-0.17%	103%	95%
Class C	-0.33%	-0.27%	-0.23%	104%	96%
Class E					
Overall	-0.27%	-0.18%	-0.20%	103%	95%
Class D	-0.34%	-0.41%	-0.11%	102%	94%

QUESTIONS AND COMMENTS?

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Thank you

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