

TE 3: MC with adaptive warped reference picture

JCTVC-B022



LG Electronics

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Outline

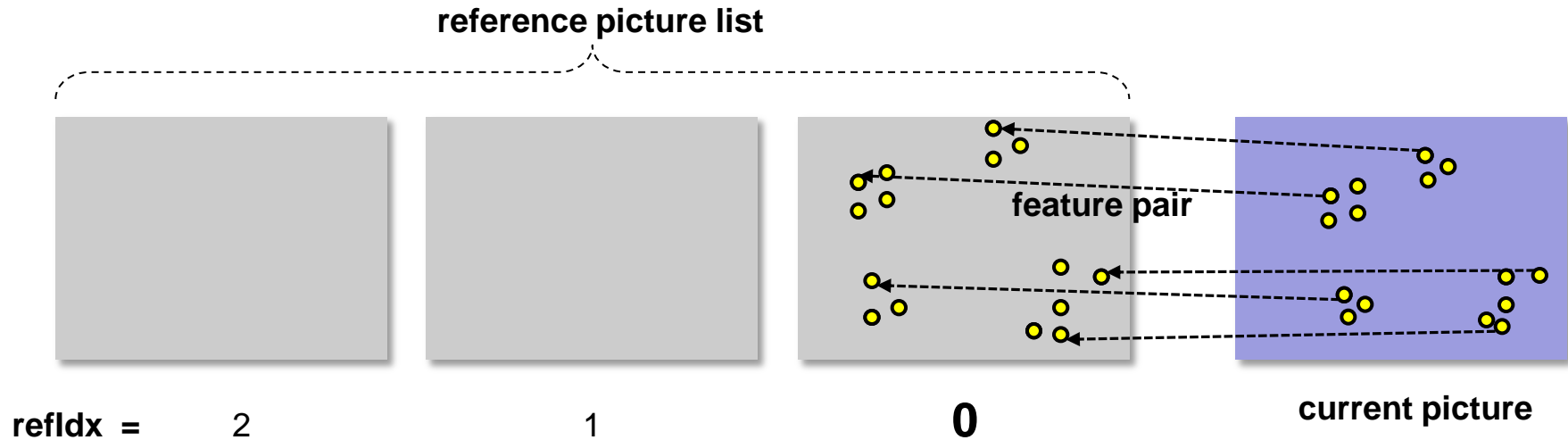
- **Introduction**
 - Brief summary of the proposed method
- **Detail description**
 - Computation of warping parameters
 - Selection of best warped picture
 - Reordering ref pic list
 - Encoding warping parameters
 - Fast encoding decision rule
- **Test condition & experimental results**
- **Conclusion**

Introduction

- **Conventional motion compensation**
 - Support only translational motion
 - Not efficient for complex motion like zooming, rotation, etc.
- **MC with adaptive warped reference picture (A021)**
 - Support warping motion including **zooming, rotation, affine, perspective transform**, etc.
 - ‘KLT feature tracking’ and ‘motion segmentation’ algorithm
 - Generate multiple warped version of the reference picture with $\text{refIdxLX}=0$
 - Choose best one among candidates
 - Reference pic list reordering
 - Fast encoding applied

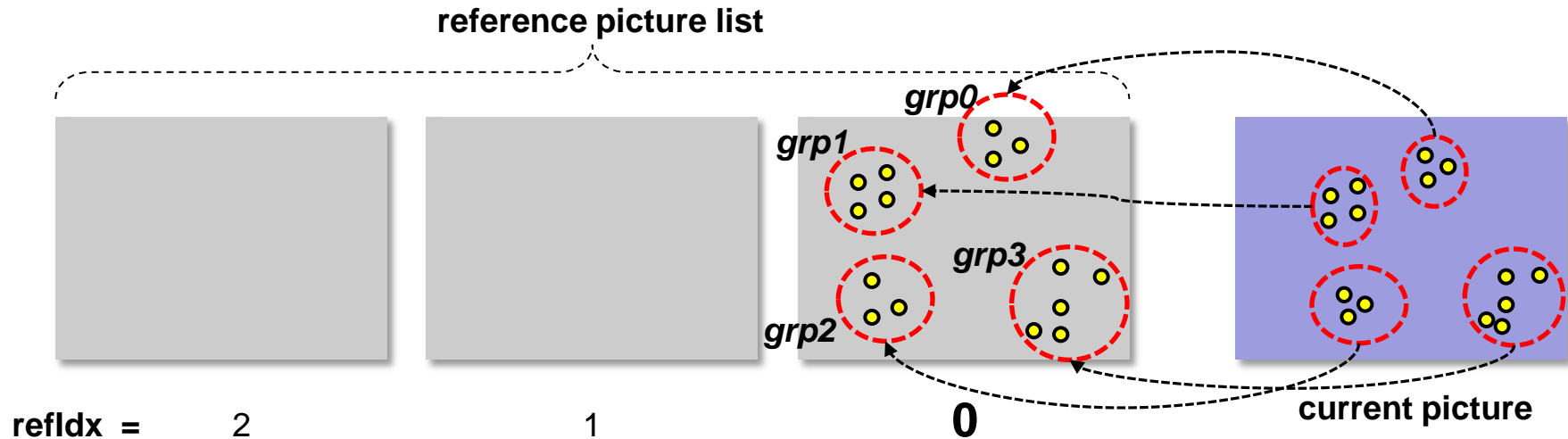
Proposed method

- **Step 1 : Computation of warping parameters**
 - Set target reference picture
 - Apply KLT (Kanade–Lucas–Tomasi) Feature Tracker



Proposed method

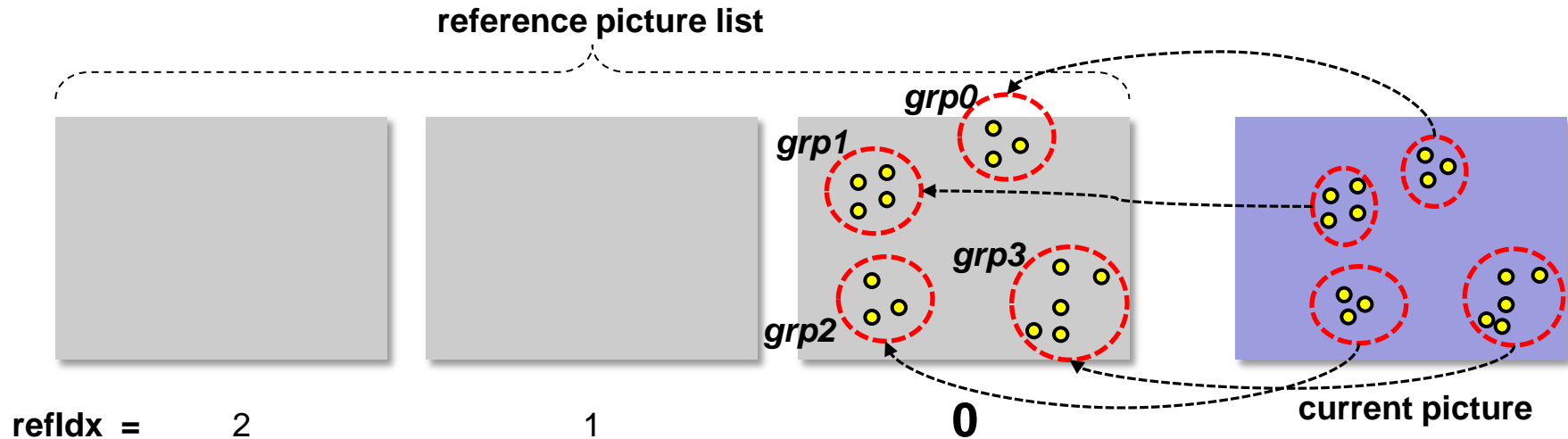
- **Step 1 : Computation of warping parameters**
 - Set target reference picture
 - Apply KLT (Kanade–Lucas–Tomasi) Feature Tracker



- Feature pairs segmented into several groups by motion segmentation

Proposed method

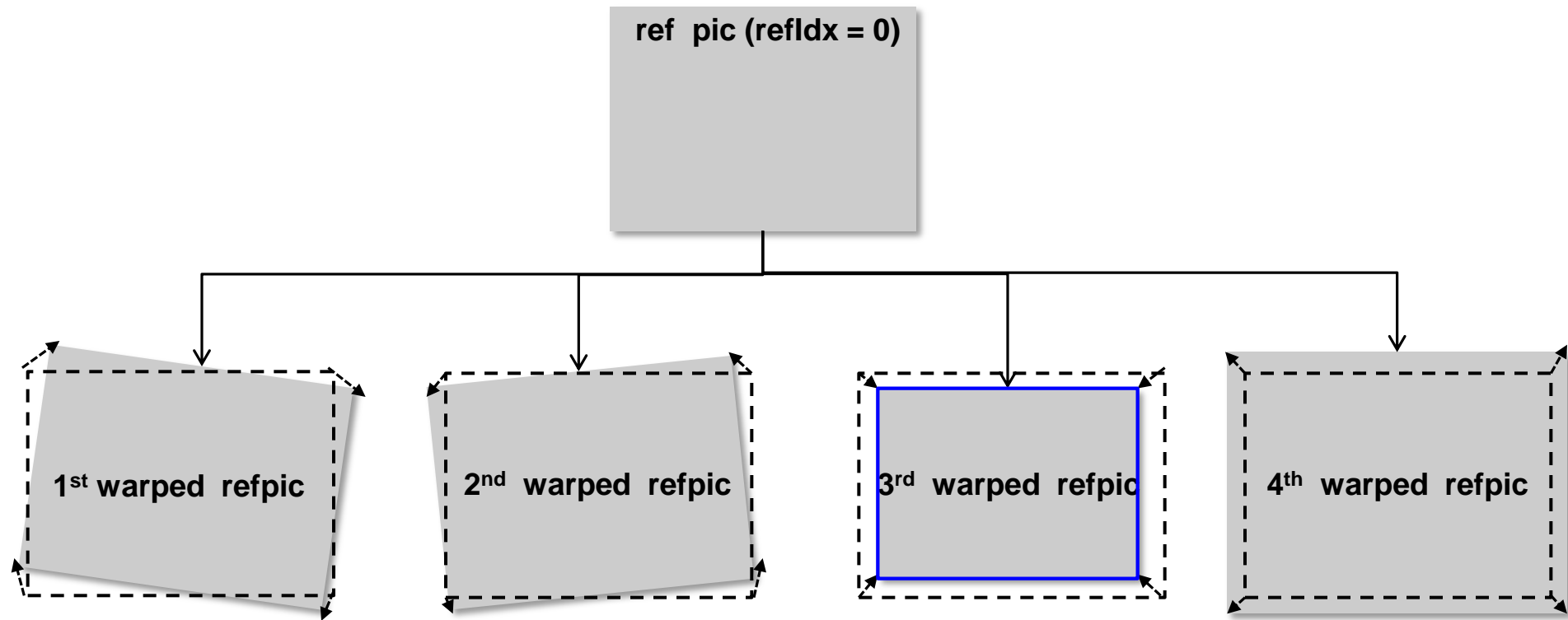
- **Step 1 : Computation of warping parameters**
 - Set target reference picture
 - Apply KLT (Kanade–Lucas–Tomasi) Feature Tracker



- Feature pairs segmented into several groups by motion segmentation
- Achieving four warping matrix by DLT (direct linear transform) to each feature group

Proposed method

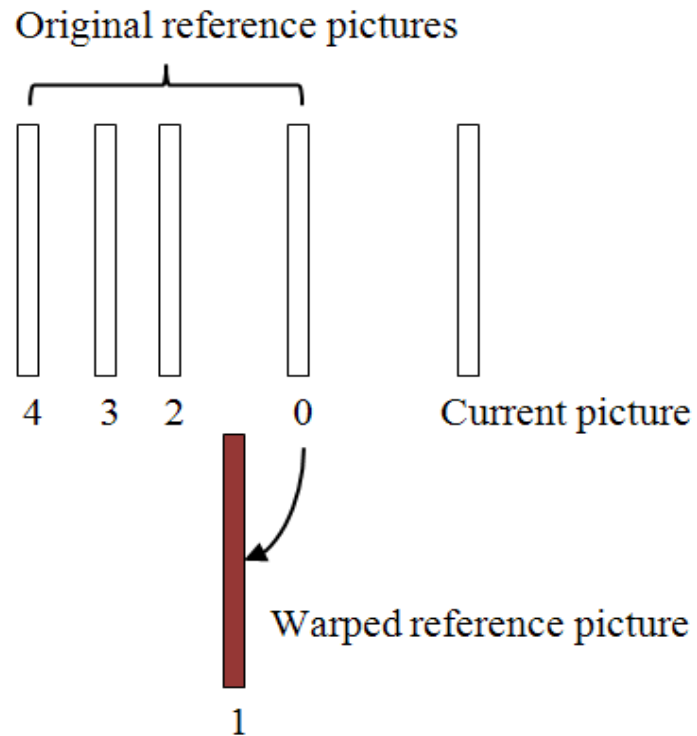
- **Step 2 : Selection of the best warped reference picture**
 - Four warped pictures generated



- Select best one having the largest number of MBs ,having the smallest SAD among candidates.

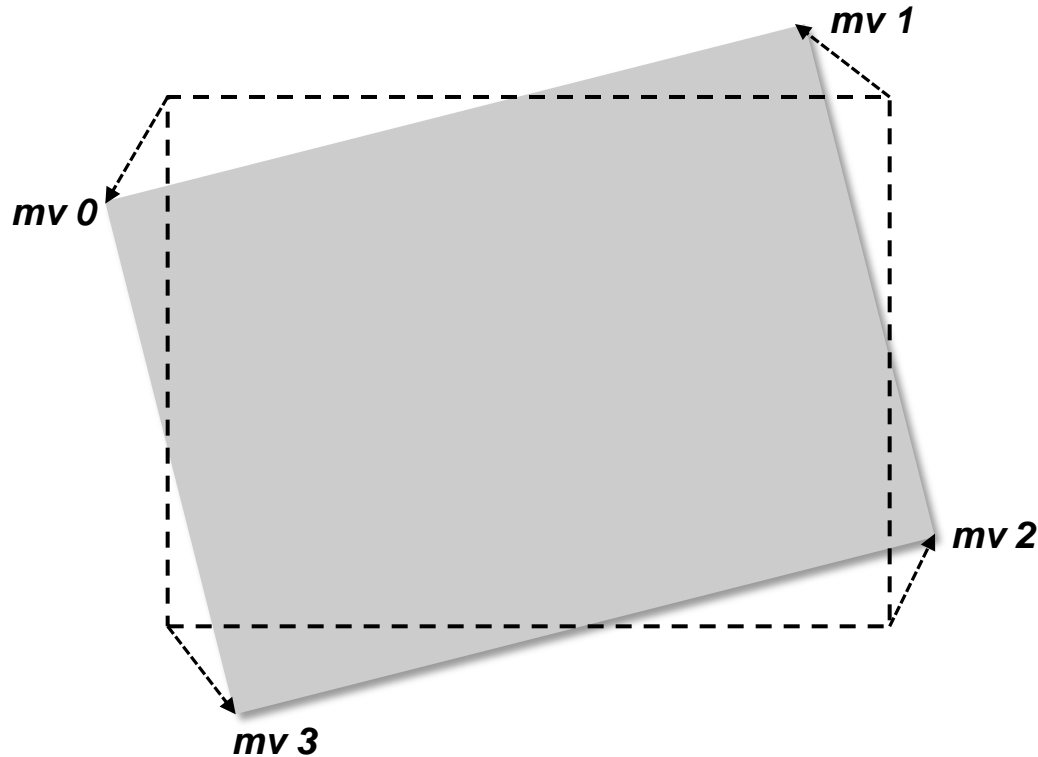
Proposed method

- **Step 3 : Reordering of the reference picture list**
 - Best warped reference picture inserted right after reference picture 0 temporally
 - Do not touch DPB and use some trick



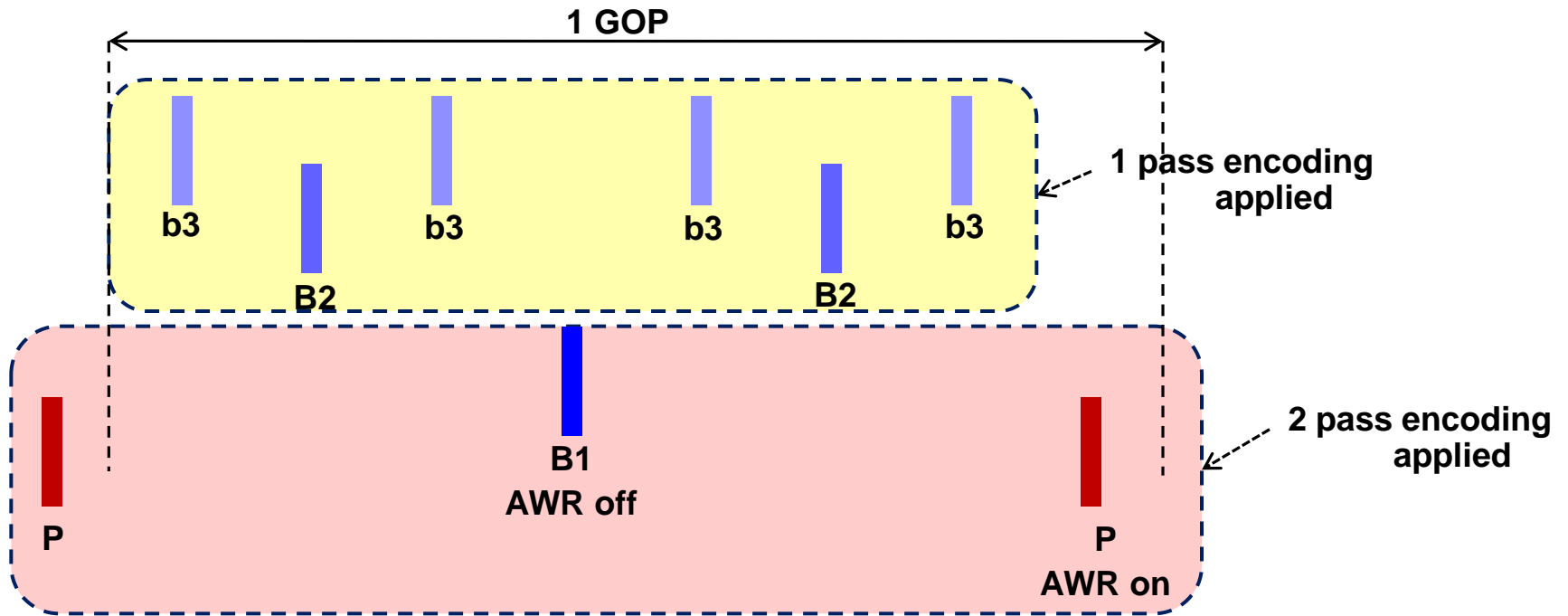
Proposed method

- **Step 4 : Warping parameters**
 - Encode four motion vectors in the slice header
 - Each vector quantized by 3 bit quantizer



Proposed method

- **Step 5 : Fast encoding method**
 - Basically 2-pass encoding applied
 - Early skip used based on the temporal level criterion
 - Proposed method not tried if previous level do not use warped ref pic



Test conditions

- **Constraints Set 1 (alpha anchor in CfP)**
 - AVC high profile
 - Hierarchical B structure (GOP length 8)
 - Max ref : 4
 - CABAC
 - 100 frames encoded
- **Constraints Set 2 (beta anchor in CfP)**
 - AVC high profile
 - Hierarchical P structure (GOP length 4)
 - Max ref : 4
 - CABAC
 - 100 frames encoded
- **Implementation on JM 17.0**

Experimental results – BD bitrates

Class	Sequences	BD-rate(%)
B	BasketballDrive	-0.16
	BQTerrace	1.13
	Cactus	-8.48
	Kimono	-0.01
	ParkScene	0.01
Class B Avg.		-1.50
C	BasketballDrill	0.04
	BQMall	0.30
	PartyScene	-0.38
	RaceHorses	-0.09
Class C Avg.		-0.03
D	BasketballPass	-0.19
	BlowingBubbles	0.01
	BQSquare	-1.24
	RaceHorses	-0.09
Class D Avg.		-0.38
CS 1 Avg.		-0.70
Extra seq	City_720p	-6.64
	Jets_720p	-17.54
	Bluesky_1080p	-25.34
	Station2_1080p	-47.06
Avg		-24.15
CS 1+ extra seq Avg		-6.21

Class	Sequences	BD-rate(%)
B	BasketballDrive	-0.04
	BQTerrace	-1.28
	Cactus	-3.41
	Kimono	0.04
	ParkScene	0.02
Class B Avg.		-0.93
C	BasketballDrill	-0.09
	BQMall	-0.04
	PartyScene	-0.04
	RaceHorses	0.02
Class C Avg.		-0.04
D	BasketballPass	-0.03
	BlowingBubbles	-0.05
	BQSquare	-0.82
	RaceHorses	-0.01
Class D Avg.		-0.23
CS 2 Avg.		-0.44
Extra seq	City_720p	-0.64
	Jets_720p	-2.18
	Bluesky_1080p	-8.60
	Station2_1080p	-17.59
Avg		-7.25
CS 2+ extra seq Avg		-2.04

Experimental results – Complexity comparison

Type of constraints set	Encoding complexity	Decoding complexity
CS 1	2.08	1.50
CS 2	2.50	1.40
Avg	2.29	1.45

- **Main reason of encoder complexity**
 - Multi-pass encoding
 - Trying to change it to the single-pass encoding
- **Main reason of decoder complexity**
 - Additional interpolation process for the warped reference picture
 - Trying to simplify the interpolation method

Conclusion

- **Proposed MC with adaptive warped reference picture**
- **Achieved 6.21% and 2.04% under CS 1 and 2 with extra test sequences**
- **TMuC supports only translational motion and need to be extended to the more flexible model**
- **Recommend adopting the proposed method into TMuC and let experts verify this tool in various test condition**