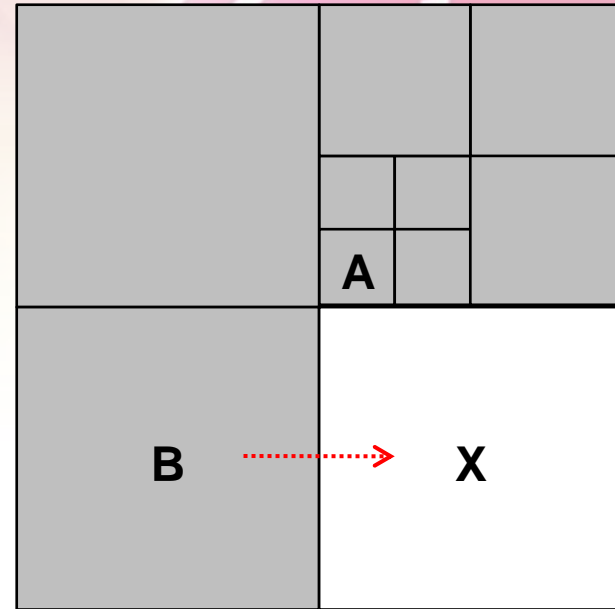
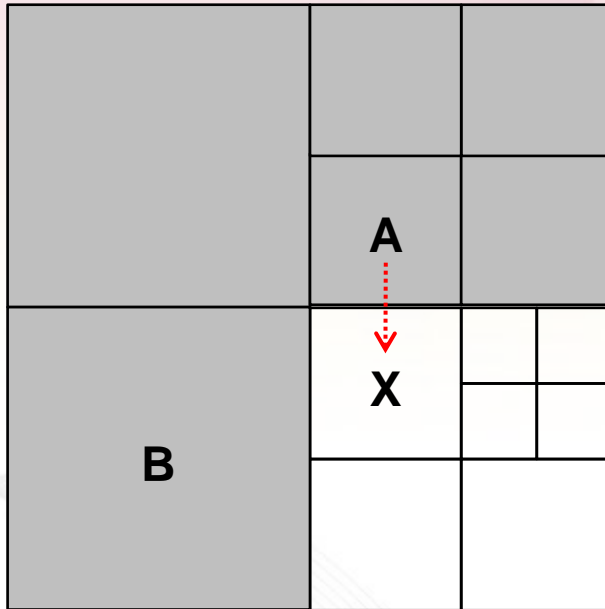


JCTVC-B023

Extended merging scheme using Motion-hypothesis inter prediction

LG Electronics

Introduction



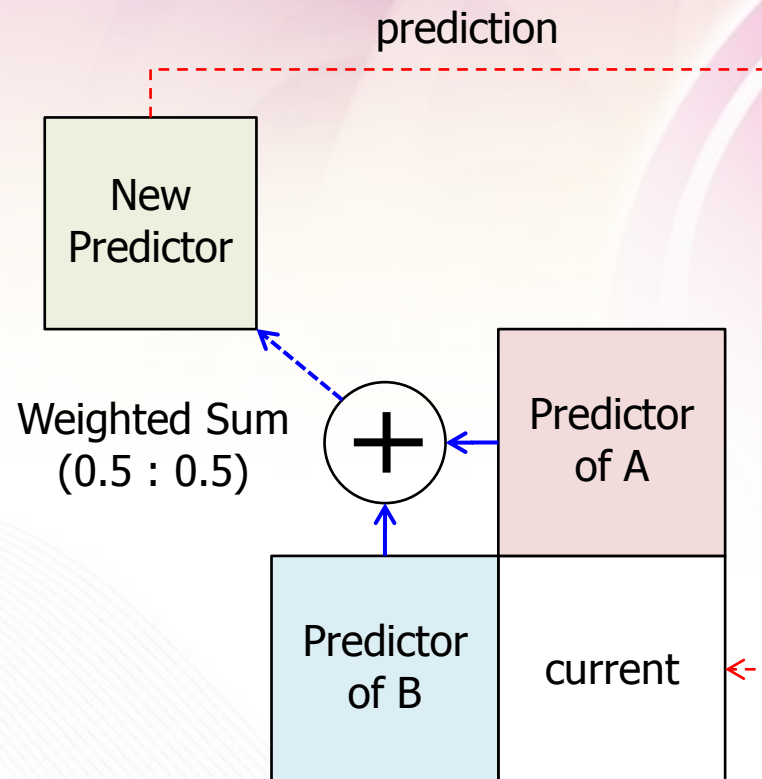
.....> : infer motion information

- **The merging process in TMuC**
 - Current motion inferred from one of A and B neighbor
 - 2 flag signaling instead of coding whole motion parameters

- **Motivation**

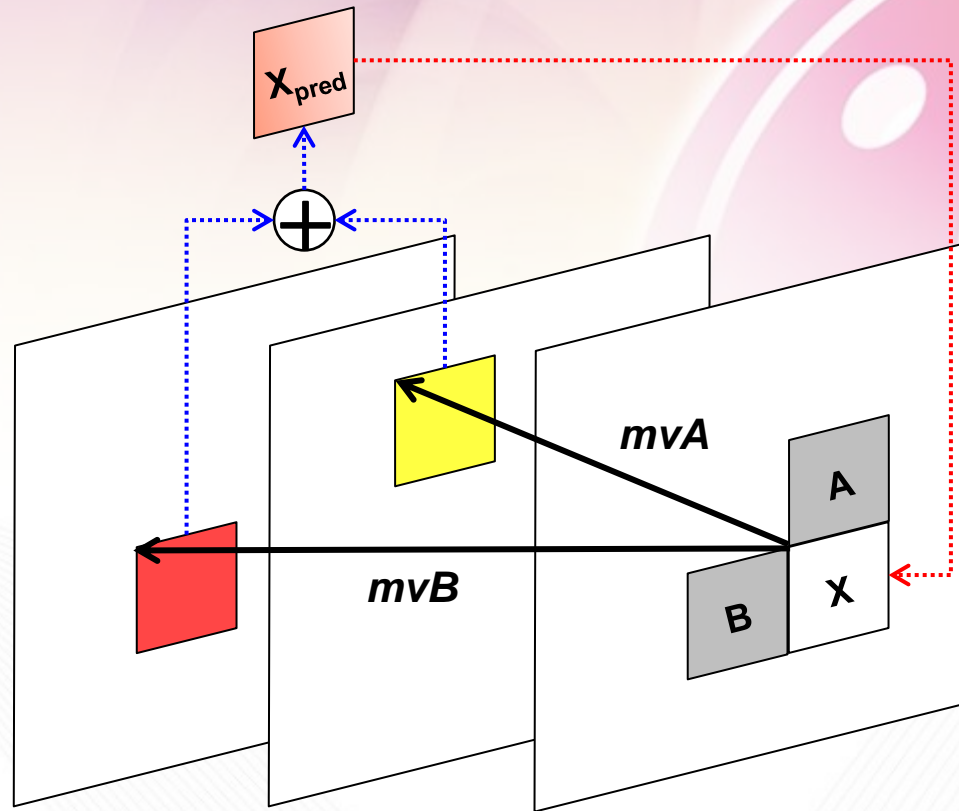
- One of two motion parameters from neighboring partitions(above and left) are available in the merging process in TMuC.
- It is known that the accuracy of motion compensated prediction can be increased with multi-hypothesis prediction.
(motion-compensated prediction using multiple motion parameters)
- For better coding efficiency, we applied motion-hypothesis inter prediction to the merging process by combine the two motion parameters of the left and the above neighboring partitions.

Proposed method



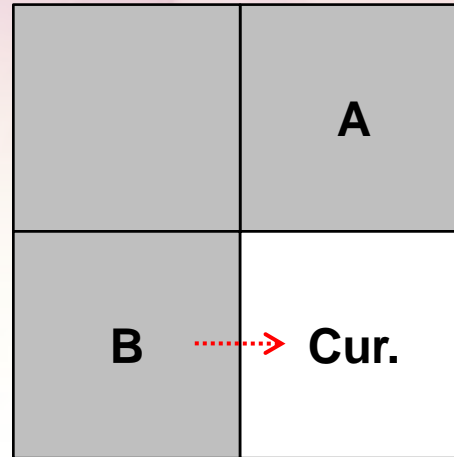
- **Extended merging scheme using motion-hypothesis inter prediction**
 - Additional predictor is obtained by the weighted sum of A and B predictor.
 - One additional flag is signaled compared to TMuC with the merging process.

Proposed method



- **Motion-hypothesis inter prediction**
 - Enhance the prediction performance especially in P picture.

Proposed method

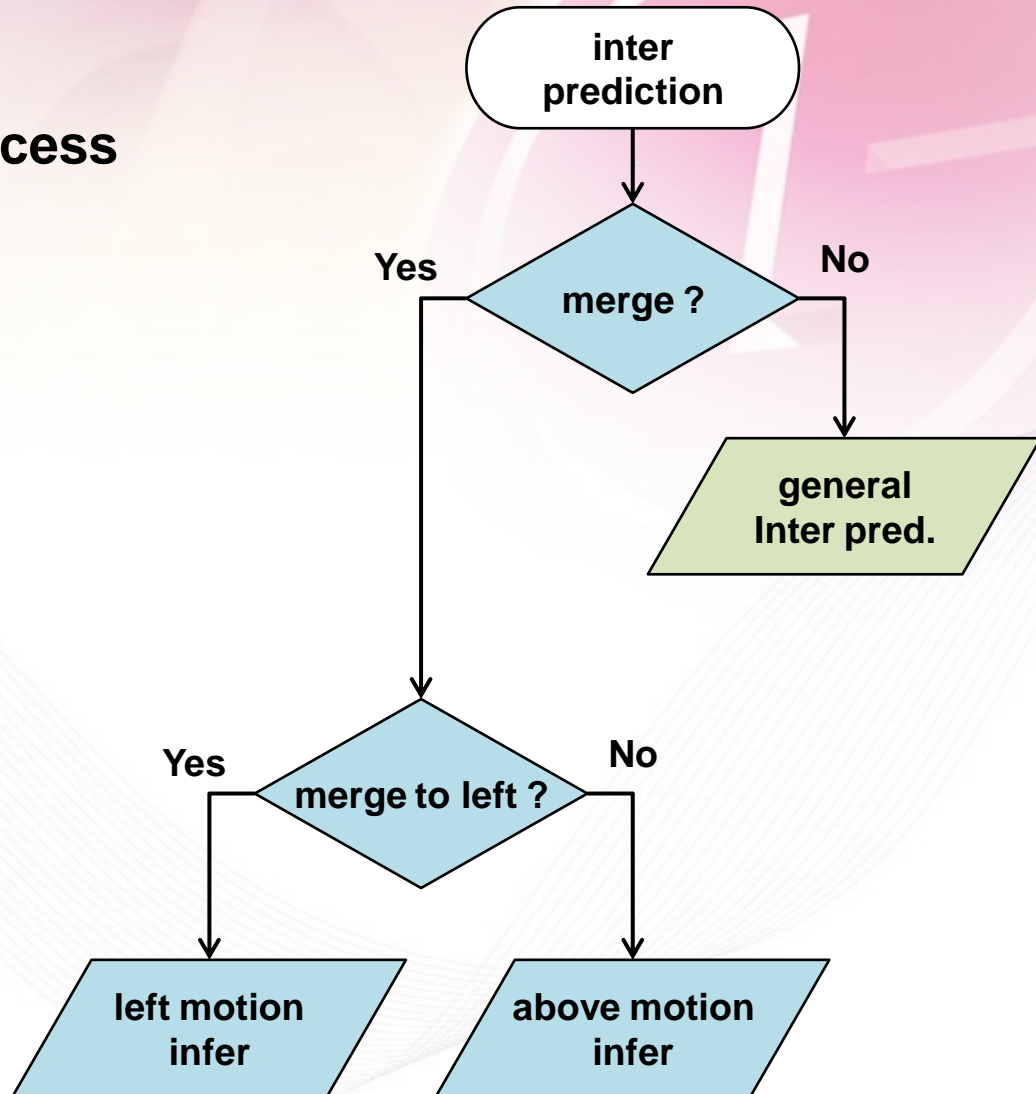


.....> : infer motion information
(after coding process)

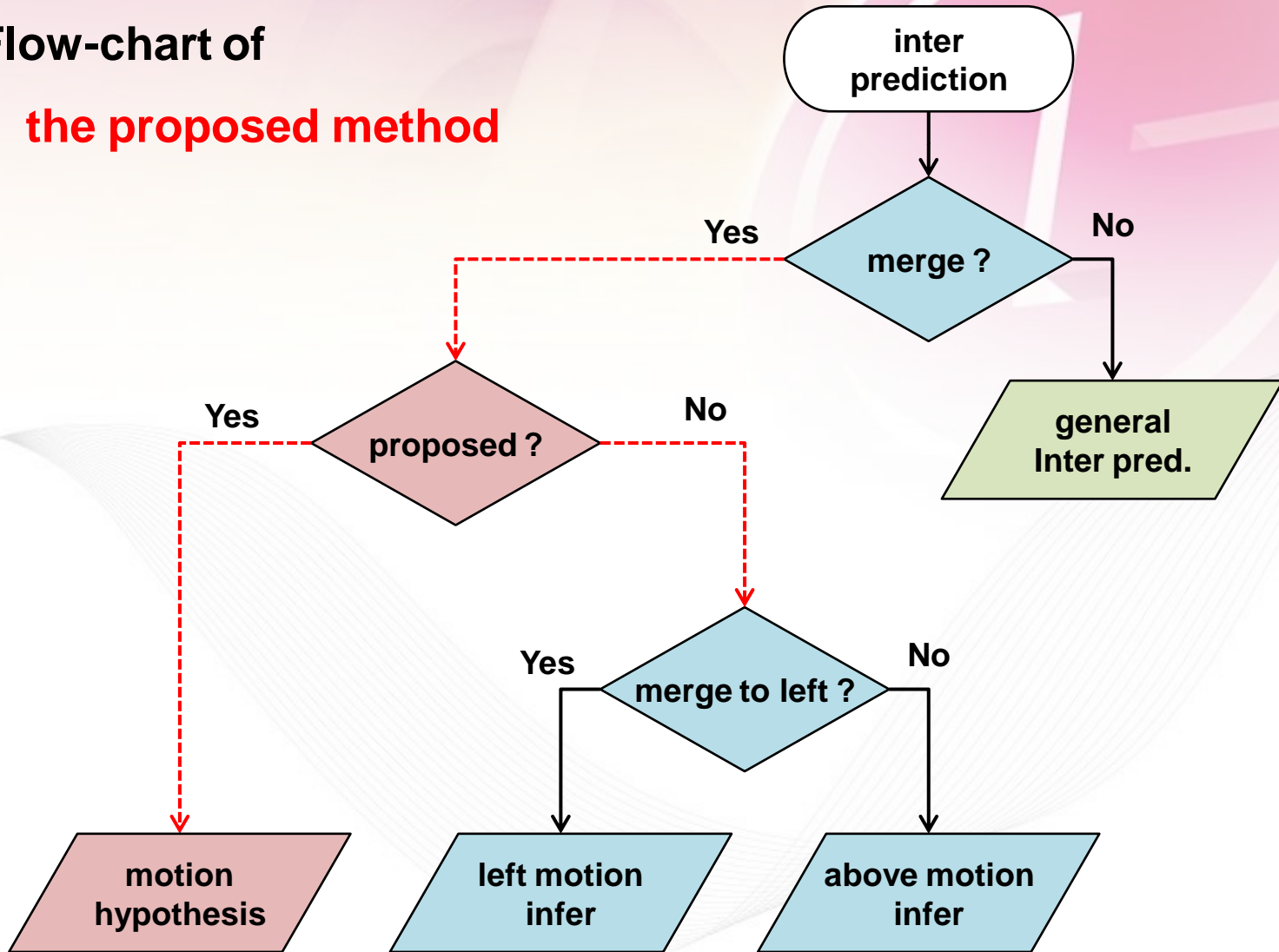
- **After coding current partition with the proposed method**
 - Current motion parameters are inferred from the left neighbor to code the following partition(right and below neighbor partitions).
 - The left motion inferred case and the above motion inferred case showed almost the same performance.

- **The merging process in TMuC**
 - Motion parameters can be inferred from one of neighbor above and left partitions.
 - In other words, MC predictor can be obtained using one of neighbor above and left motion parameters.
- **Proposed method**
 - MC predictor can be obtained using the merging process.
 - Or, MC predictor can be obtained using both of neighbor above and left motion parameters.
 - Enhance the prediction performance especially in P picture.

- Flow-chart of the merging process



- Flow-chart of
the proposed method



- Syntax table of the merging process**

prediction_unit(x0, y0, currPredUnitSize) {		
:		
else if(PredMode == MODE_INTER) {		
if(entropy_coding_mode_flag)		
inter_partitioning_idc	2	ue(v) ae(v)
for(i= 0; i < NumPuParts(inter_partitioning_idc); i++) {		
if(NumMergeCandidates > 0) {		
merge_flag[i]	2	ue(1) ae(v)
if(merge_flag[i] && NumMergeCandidates > 1)		
merge_left_flag[i]	2	ue(1) ae(v)
}		
:		
}		
}		
:		
}		
}		
:		
}		

- Syntax table of the proposed method**

prediction_unit(x0, y0, currPredUnitSize) {		
:		
else if(PredMode == MODE_INTER) {		
if(entropy_coding_mode_flag)		
inter_partitioning_idc	2	ue(v) ae(v)
for(i= 0; i < NumPuParts(inter_partitioning_idc); i++) {		
if(NumMergeCandidates > 0) {		
merge_flag[i]	2	ue(1) ae(v)
if(merge_flag[i] && NumMergeCandidates > 1)		
motion_hypothesis_merge_flag[i]	2	ue(1) ae(v)
If(motion_hypothesis_merge_flag[i] !=1)		
merge_left_flag[i]	2	ue(1) ae(v)
}		
:		
}		
}		
:		
}		

Test condition

- **Test condition for the proposed method**

software	TMuC software revision 11 (HHI tool integrated version)
test sequences	Class B (100-frame), Class C/D (all-frame)
coding structure	Hierarchical-P and IPPP (the same as the TMuC software batches)
QP	Higher 4 QP s (the same QP s in the TMuC software batches)
etc	the same as the HHI released TMuC software configuration

Performances

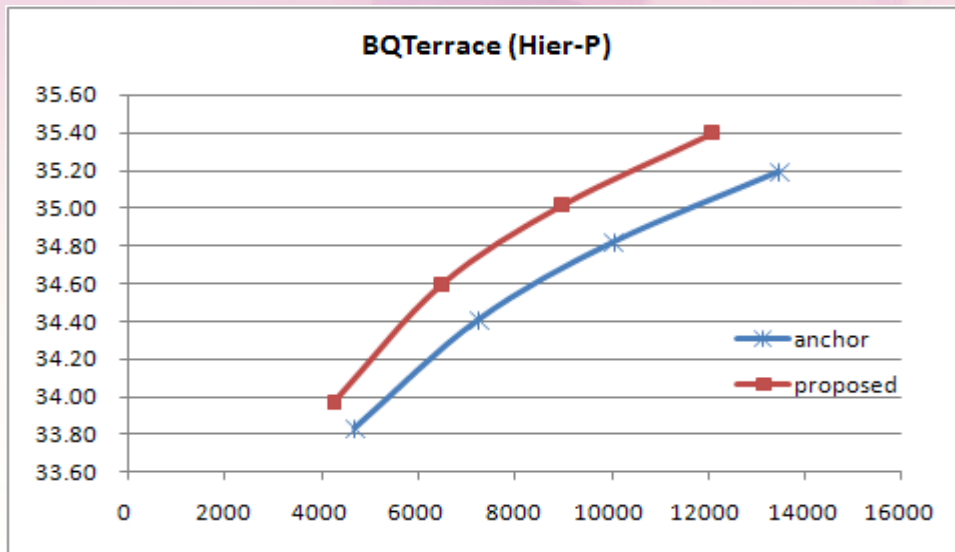
< BD rate(%) reduction of the proposed method under Hier-P, IPPP condition >

Class	seq.	BD-rate(%)	
		Hier-P	IPPP
B	BasketballDrive	-1.27	-1.96
	BQTerrace	-22.15	-21.99
	Cactus	-2.16	-2.13
	Kimono	-0.41	-0.33
	ParkScene	-0.55	-0.67
Class B Avg.		-5.31	-5.42
C	BasketballDrill	-2.40	-2.75
	BQMall	-0.69	-0.92
	PartyScene	-1.25	-1.34
	RaceHorses	-0.58	-0.91
Class C Avg.		-1.23	-1.48
D	BasketballPass	-0.08	-0.12
	BlowingBubbles	-1.54	-2.07
	BQSquare	-7.17	-9.25
	RaceHorses	-0.39	-0.60
Class D Avg.		-2.29	-3.01
Avg. all		-2.94	-3.30

- **BD-rate reduction**

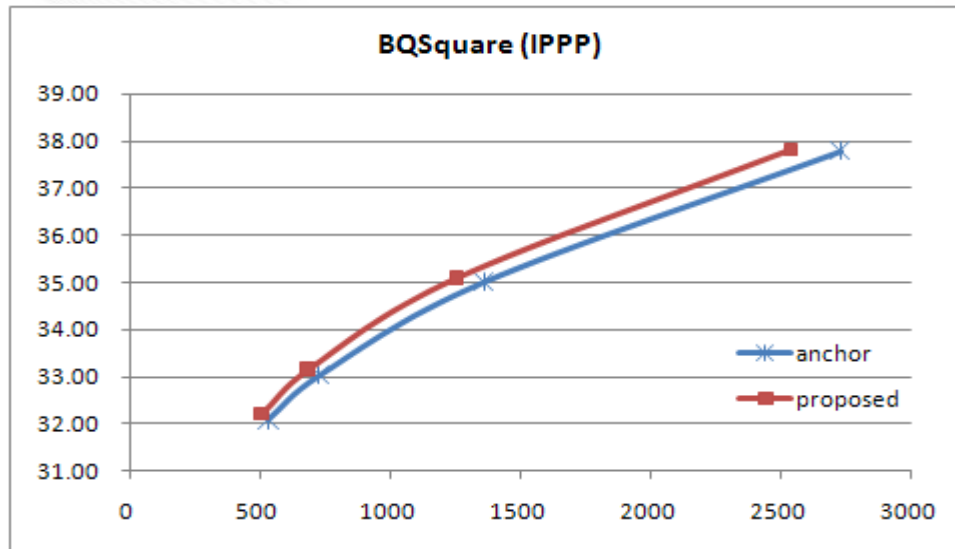
- Avg. gain for class B/C/D : 2.94%(Hier-P), 3.30%(IPPP)
- Max gain : 22.15%(BQTerrace, Hier-P), 9.25%(BQSquare, IPPP)

Performances



- BD-rate
-22.15% under Hier-P
-21.99% under IPPP

< R-D curve of BQTerrace test sequence under Hier-P condition >



- BD-rate
-7.17% under Hier-P
-9.25% under IPPP

< R-D curve of BQSquare test sequence under IPPP condition >

Performances

< Complexity increment of the proposed method compared with TMuC >

class	sequence	Hier-P		IPPP	
		encoder	decoder	encoder	decoder
B	BasketballDrive	1.04	1.05	1.07	1.05
	BQTerrace	1.01	1.10	1.04	1.04
	Cactus	1.00	1.04	1.03	1.03
	kimono	1.01	1.03	1.03	1.03
	ParkScene	1.04	1.08	1.02	1.04
Class B Avg.		1.02	1.06	1.04	1.04
C	BasketballDrill	1.02	1.05	1.02	1.01
	BQMall	1.02	1.02	0.97	1.05
	PartyScene	1.02	1.05	1.04	1.03
	RaceHorses	1.01	1.03	1.05	1.03
Class C Avg.		1.02	1.04	1.02	1.03
D	BasketballPass	1.01	1.01	1.03	1.08
	BlowingBubbles	1.01	1.06	1.02	1.02
	BQSquare	1.02	1.18	1.02	1.11
	RaceHorses	1.01	1.03	0.98	1.06
Class D Avg.		1.01	1.07	1.01	1.07
Avg. all		1.02	1.06	1.02	1.05

- **Complexity increment compared with TMuC**
 - Encoder : avg. 1.02x, 1.02x under Hier-P and IPPP conditions
 - Decoder : avg. 1.06x, 1.05x under Hier-P and IPPP conditions

Conclusion

- **Extended merging scheme using Motion-Hypothesis inter prediction is proposed.**
- **Motion-Hypothesis inter prediction is a useful coding method because it shows significant bit-rate reduction while the complexity is negligible.**
 - Avg. gain for class B/C/D : 2.94%(Hier-P), 3.30%(IPPP)
 - Avg. complexity for class B/C/D : 1.02x/1.06x(encoder/decoder ; Hier-P)
1.02x/1.05x(encoder/decoder ; IPPP)
- **We recommend enabling this technique in the merging process in the TMuC.**
- **If it is required to be further evaluated on the proposal, we recommend JCT-VC to establish a TE or ad-hoc on this topic.**