

Inter-layer motion prediction using FGS refined motion

(JVT-T058)

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Introduction

- Currently in JSVM, the inter-layer motion prediction is based on the base quality layer of lower spatial resolution
- Beside, JSVM has an option of motion refinement in FGS layers.
- We propose to use the motion information in FGS layer for inter-layer motion prediction.

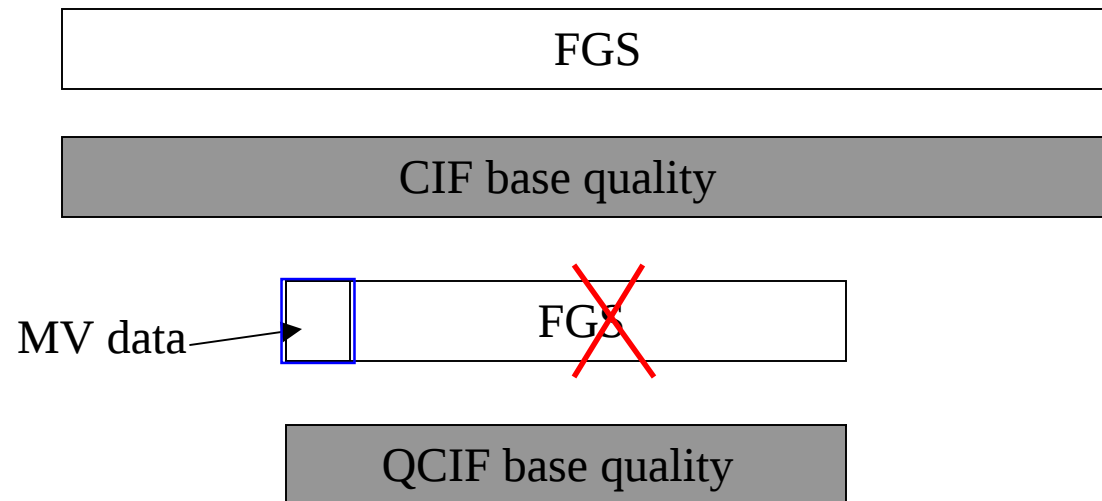
Proposed approach

- Suppose that motion refinement is enabled in FGS layers.
- At encoder, the motion vectors of the FGS layer identified by `base_id_plus1` element are used for prediction.
- At decoder, the motion refinement is not only carried for FGS layers of highest spatial resolution, but also for FGS layers of lower spatial resolutions.
- To signal the use of FGS motion for inter layer prediction, we propose the `use_fgs_motion_flag` in the slice header

slice_header_in_scalable_extension() {		
.....		
if(slice_type == PR && fragment_order == 0) {		
adaptive_ref_fgs_flag	2	u(1)
if(adaptive_ref_fgs_flag) {		
max_diff_ref_scale_for_zero_base_block	2	u(5)
max_diff_ref_scale_for_zero_base_coeff	2	u(5)
fgs_entropy_order_flag	2	u(1)
}		
motion_refinement_flag	2	u(1)
}		
if(slice_type == EP slice_type == EB)		
use_fgs_motion_flag	2	u(1)
SpatialScalabilityType = spatial_scalability_type()		
}		

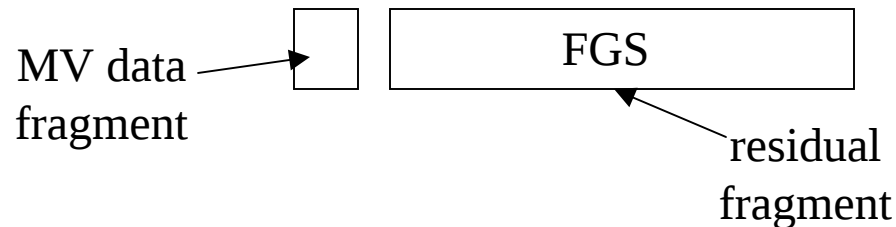
Proposed approach

- In this approach, the motion information in FGS layers should not be truncated when it is used for higher spatial resolution.



Proposed approach

- For this, we suggest three alternatives.
 - In first two alternatives, the FGS motion information is stored in a special FGS fragment.
 - Motion-containing fragment is identified either
 - by a flag in the place of existing reserved_zero_bit
 - or by a special value of simple_priority_id.



- Third alternative: using a SEI message

Alternative 1

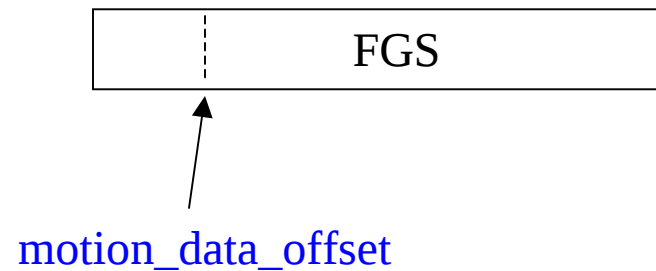
<code>nal_unit_header_svc_extension() {</code>	C	Descriptor
<code>simple_priority_id</code>	All	u(6)
<code>discardable_flag</code>	All	u(1)
<code>reserved_zero_bit</code> <code>fgs_motion_flag</code>	All	u(1)
<code>temporal_level</code>	All	u(3)
<code>dependency_id</code>	All	u(3)
<code>quality_level</code>	All	u(2)
<code>nalUnitHeaderBytes += 2</code>		
<code>}</code>		

Alternative 2

nal_unit_header_svc_extension() {		C	Descriptor
simple_priority_id	Use a reserved value of simple_priority_id, e.g. 63, to identify the FGS motion fragments	All	u(6)
discardable_flag		All	u(1)
reserved_zero_bit		All	u(1)
temporal_level		All	u(3)
dependency_id		All	u(3)
quality_level		All	u(2)
nalUnitHeaderBytes += 2			
}			

Alternative 3

FGS_motion_data(payloadSize) {	C	Descriptor
motion_data_offset	5	ue(v)
}		



- Even slice header may be possibly a choice!

Experiment

- The proposed approach was implemented in JSVM 5.7.
- Conventional QPs as specified in JVT-Q205; GOP size equal to 16
- Encode with QCIF@15 and CIF@30, each has 3 FGS layers.

	QP	Frame rate
Experiment 1	Conventional	QCIF@15fps, CIF@30fps
Experiment 2	Higher QP for QCIF layer (increased by 3 and 6)	QCIF@15fps, CIF@30fps
Experiment 3	Conventional	QCIF@30fps, CIF@30fps

Experiment

- Using conventional QPs as specified in JVT-Q205
- Encode with QCIF@15fps and CIF@30fps

Table 2: Bitrate reduction (%) using the proposed approach.

Layers	Bus	Soccer	Crew	City
CIF base quality	1.29%	0.86%	4.42%	0.70%
CIF FGS1	0.36%	0.33%	0.90%	-0.06%
CIF FGS2	1.34%	0.64%	2.03%	0.16%
CIF FGS3	3.87%	1.49%	0.73%	0.98%
Total (QCIF+CIF)	1.90%	0.88%	1.00%	0.50%

- We can see that there are always some improvement at CIF base quality layer, even it can be up to 4.42% (Crew sequence).
- Also, the proposed approach can result in some savings at FGS layers.

Experiment

- Increase the QPs of QCIF by 6
- Encode with QCIF@15fps and CIF@30fps

Table 5: Bitrate reduction (%) using the proposed approach (QP increased by 6)

Layers	Bus	Soccer	Crew	City
CIF Base quality	6.85%	2.59%	9.78%	3.43%
CIF FGS1	0.66%	0.14%	2.62%	-0.02%
CIF FGS2	3.30%	0.72%	0.55%	1.21%
CIF FGS3	5.22%	2.07%	-0.50%	3.35%
Total (QCIF+CIF)	3.62%	1.35%	0.53%	2.07%

- When QCIF has lower quality, the proposed approach provide more saving

Experiment

- Using conventional QPs as specified in JVT-Q205
- Encode with QCIF@30fps (doubled) and CIF@30fps

Table 3: Bitrate reduction (%) using the proposed approach
(base frame rate is doubled)

Layers	Bus	Soccer	Crew	City
CIF Base quality	4.44%	1.91%	8.70%	2.46%
CIF FGS1	0.16%	0.43%	1.97%	0.18%
CIF FGS2	1.25%	1.74%	7.29%	0.52%
CIF FGS3	5.89%	4.63%	4.11%	2.74%
Total (QCIF+CIF)	2.42%	2.36%	3.38%	1.14%

- When QCIF frame rate is doubled, the bitrate saving is also doubled or more

Conclusion

- In this contribution, we propose to use the refined motion in FGS layer for inter layer prediction
- We also suggest several alternatives to protect the motion part in FGS layers
- The experiments show good bitrate saving in base quality layer as well as FGS layer (of higher spatial layers)
- It is recommended to create a CE to further verify the proposal as well as the signaling alternatives.