



JCTVC-E280: Picture Orientation Information

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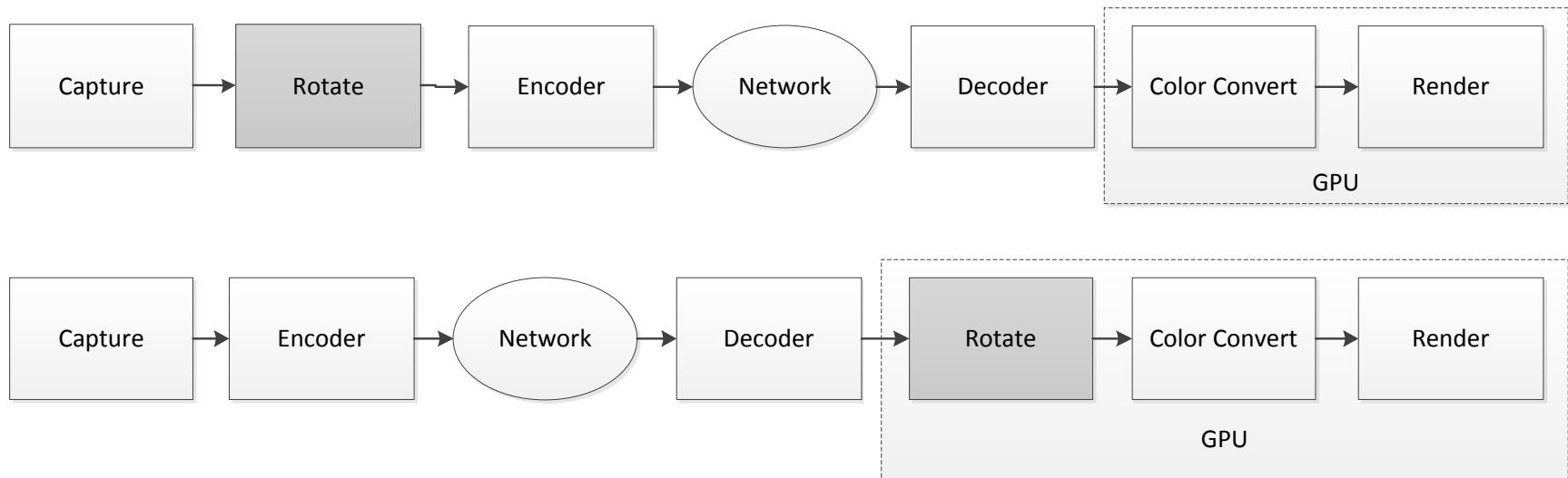
Introduction

- Mobile handheld devices (cellphones, digital cameras) can be held in different orientations (portrait, landscape)
- Motion sensors can detect orientation
- Proper viewing requires that rotation be performed



System GPU Utilization

- Rotation can be performed at capture end, prior to encode OR at display end, after decode
- GPUs commonly used after decode for color conversion, rendering
- Mobile phone videoconferencing system complexity reduced by performing rotation in GPU following decoding, along with other GPU functions



Proposal

- **Add orientation information per sequence**
 - In VUI, SPS or SEI message
 - Recommend VUI
 - 4 rotation positions – 0, 90, 180, or 270 degrees

vui_parameters () {	Descriptor
...	
orientation_idc	u(2)
...	

orientation_idc specifies if rotation be performed following video decoding. **orientation_idc** equal to 0 specifies no rotation. **orientation_idc** * 90 degrees specifies the clockwise rotation of the image following decoding, as detailed in subclause X. **orientation_idc** shall be in the range of 0 to 3, inclusive.

Coding Efficiency Experiments

- While primary motivation for this contribution is to allow for overall end-to-end system complexity allocation and reduction for certain applications, it has also been observed that coding efficiency savings can be achieved for some sequences when rotation is used
- Test sequences rotated 90 degrees counter clockwise (or 270 degrees clockwise) prior to encoding, for the decoder to rotate 90 clockwise
- Experiments with HM 2.0 and HM-2.0-dev-slices with 1500 bytes
- Naïve encoder always rotates
- Intelligent encoder doesn't rotate if rotation causes loss for sequence

Rotation without slices

	Intra LoCo			Intra Intelligent LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	-3.4	-5.5	-4.2	-3.4	-5.5	-4.2
Class B	-0.4	-1.1	-1.7	-0.7	-1.6	-2.2
Class C	2.0	2.2	2.0	0.0	0.0	0.0
Class D	0.3	0.5	0.5	-0.2	-0.3	-0.2
Class E	-0.1	-1.4	-1.9	-0.2	-1.0	-1.1
All	0.0	-0.5	-0.7	-0.7	-1.3	-1.3

	Random access LoCo			Random access LoCo Int Enc		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	-2.5	-4.4	-3.7	-2.5	-4.4	-3.7
Class B	-0.3	-0.5	-1.6	-0.5	-1.3	-2.0
Class C	0.4	0.5	1.0	0.0	0.1	0.1
Class D	0.2	0.6	0.2	-0.1	-0.2	-0.6
Class E						
All	-0.3	-0.4	-0.7	-0.5	-1.1	-1.3

	Low delay LoCo			Low delay LoCo Int Enc		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A						
Class B	-0.3	0.3	0.7	-0.3	0.1	0.4
Class C	0.0	0.2	0.2	-0.2	-0.1	-0.1
Class D	0.0	0.3	0.5	-0.1	-0.2	0.2
Class E	-0.1	-0.8	-1.4	-0.2	-0.2	-0.3
All	-0.1	0.1	0.1	-0.2	-0.1	0.1

	Intra			Intra Intelligent Enc		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	-2.9	-4.2	-3.3	-2.9	-4.2	-3.3
Class B	-0.1	-0.4	-0.8	-0.5	-1.1	-1.7
Class C	1.6	1.7	1.3	0.0	0.0	0.0
Class D	0.2	0.5	0.5	-0.2	-0.2	-0.2
Class E	-0.1	-1.2	-1.6	-0.2	-0.5	-1.6
All	0.0	-0.3	-0.5	-0.5	-0.9	-1.1

	Random access			Random access Int Enc		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	-2.6	-3.3	-2.6	-2.6	-3.3	-2.6
Class B	0.2	0.1	-0.7	-0.3	-0.9	-1.4
Class C	0.2	0.5	0.6	0.0	0.0	0.0
Class D	0.2	0.6	0.6	-0.1	-0.4	-0.1
Class E						
All	-0.2	-0.1	-0.2	-0.5	-0.8	-0.9

	Low delay			Low delay Int Enc		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A						
Class B	0.0	0.5	0.1	-0.3	-0.1	-0.3
Class C	0.1	0.8	0.5	-0.1	0.5	0.3
Class D	-0.4	0.7	0.0	-0.5	0.5	-0.2
Class E	-0.2	-0.1	0.1	-0.4	-0.1	-0.1
All	-0.1	0.5	0.2	-0.3	0.2	-0.1

Rotation with slices

	Intra LoCo			Intra Intelligent LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	-1.5	-2.4	-1.2	-1.5	-2.4	-1.2
Class B	-0.1	-0.4	-0.5	-0.5	-0.9	-1.2
Class C	1.0	1.0	0.9	-0.2	-0.2	-0.2
Class D	0.0	0.0	0.2	-0.2	-0.3	-0.1
Class E	-2.0	-4.3	-4.6	-2.0	-4.3	-4.6
All	-0.3	-0.8	-0.8	-0.7	-1.3	-1.3

	Random access LoCo			Random access LoCo Int Enc		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	-1.6	-2.7	-2.0	-1.6	-2.7	-2.0
Class B	-0.7	-0.6	-1.0	-0.7	-0.6	-1.0
Class C	-0.5	-0.4	0.1	-0.7	-0.5	-0.2
Class D	-0.1	0.3	0.4	-0.2	-0.2	0.1
Class E						
All	-0.6	-0.6	-0.5	-0.7	-0.7	-0.6

	Low delay LoCo			Low delay LoCo Int Enc		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A						
Class B	-0.8	0.1	-0.1	-0.8	0.1	-0.1
Class C	-0.6	-0.2	-0.2	-0.6	-0.2	-0.1
Class D	-0.2	0.2	0.1	-0.2	0.2	0.0
Class E	-0.1	-1.5	-3.3	-0.2	-0.4	-1.9
All	-0.5	-0.2	-0.7	-0.5	-0.1	-0.4

Conclusion

- **Proposal allows applications to allocate complexity for total system complexity optimization**
 - Especially for mobile videoconferencing clients
- **Side benefit of modest coding efficiency gains**
- **Could be a profile-specific tool, if some applications consider rotation after decoding to add significant complexity**