

JVET-AH0141

Sharp motion compensation filter for bi-prediction

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Proposal summary

1. Proposal to define a new motion compensation filter to be used for bi-prediction.
2. A 12-tap cos-windowed sinc filter with sharper filter properties is proposed.
3. The existing 12-tap filter in ECM is still used for uni-prediction. No change proposed for chroma filters, affine filters or RPR filters.
4. Average BD-Rate(PSNR-Y/U/V) impact of -0.07%/-0.03%/-0.05% for RA and -0.07%/-0.21%/-0.39% for LDB with no encoder or decoder time impact.

Introduction

Hypothesis:

Bi-prediction generally involves more filtering operations than uni-prediction. Applying sharpening to the reference samples could potentially alleviate loss of information.

Proposed solution:

A motion compensation filter with sharper filter properties.

Background

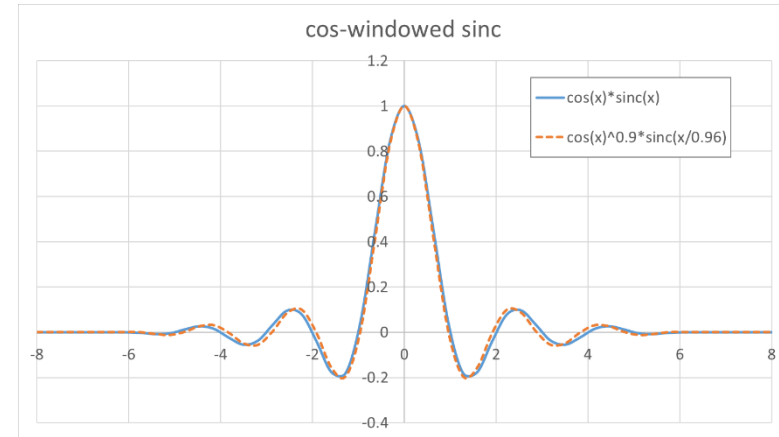
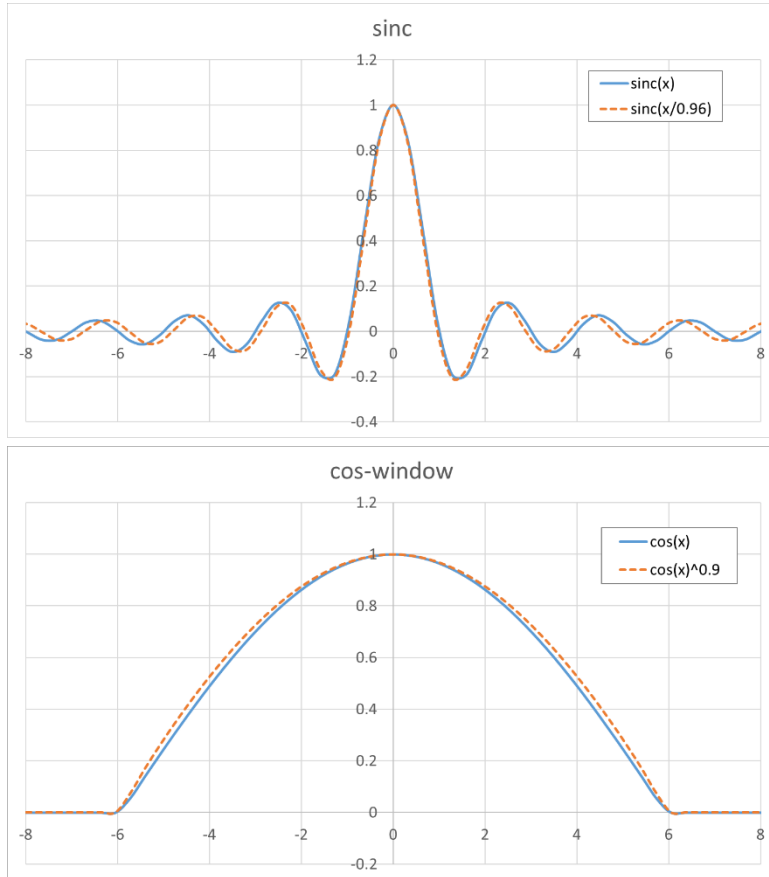
Generalized form of cos-windowed sinc:

$$f(x) = \cos^a(Ax) \operatorname{sinc}\left(\frac{x}{b}\right)$$

$$\operatorname{sinc}(x) = \begin{cases} \frac{\sin(\pi x)}{\pi}, & x \neq 0 \\ 1, & x = 0 \end{cases}$$

a and b have been selected to be slightly lower than 1 (instead of equal to 1)

Background

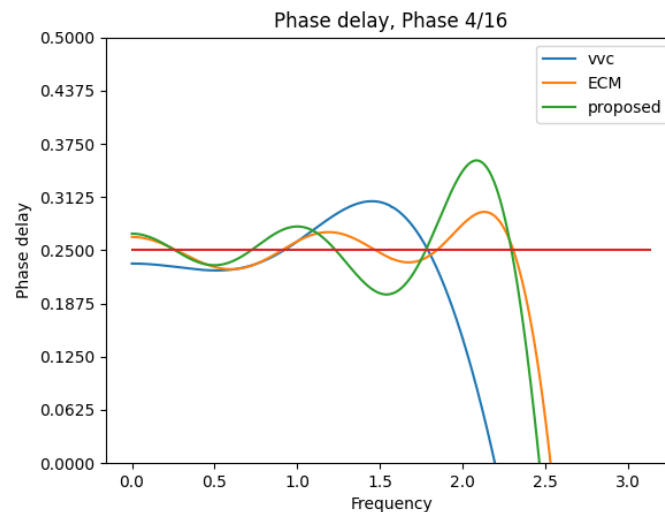
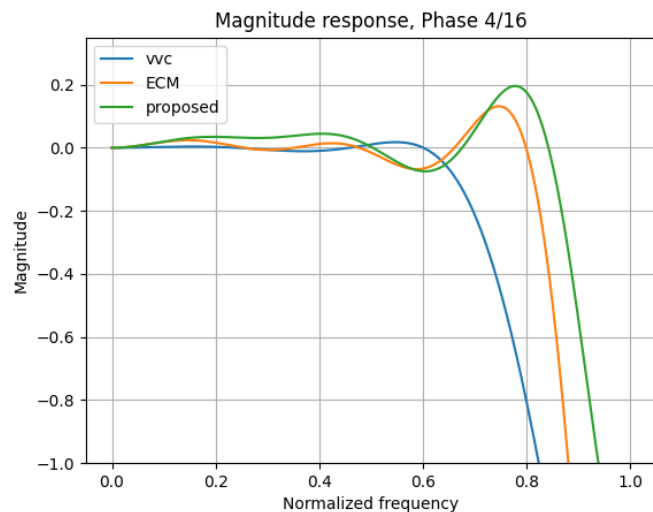


ECM filter

```
proposedBiPredFilter = {  
  { 0, 0, 0, 0, 0, 256, 0, 0, 0, 0, 0, 0},  
  { -1, 3, -5, 8, -16, 256, 15, -6, 3, -1, 0, 0},  
  { -2, 5, -9, 15, -30, 253, 32, -12, 5, -2, 1, 0},  
  { -3, 7, -12, 21, -40, 244, 50, -18, 9, -4, 2, 0},  
  { -3, 8, -15, 25, -48, 235, 71, -25, 12, -6, 2, 0},  
  { -3, 9, -16, 28, -53, 220, 93, -32, 16, -8, 3, -1},  
  { -3, 8, -16, 28, -54, 204, 116, -39, 19, -10, 4, -1},  
  { -2, 8, -15, 27, -53, 183, 139, -45, 22, -12, 5, -1},  
  { -2, 6, -13, 25, -50, 162, 162, -50, 25, -13, 6, -2},  
  { -1, 5, -12, 22, -45, 139, 183, -53, 27, -15, 8, -2},  
  { -1, 4, -10, 19, -39, 116, 204, -54, 28, -16, 8, -3},  
  { -1, 3, -8, 16, -32, 93, 220, -53, 28, -16, 9, -3},  
  { 0, 2, -6, 12, -25, 71, 235, -48, 25, -15, 8, -3},  
  { 0, 2, -4, 9, -18, 50, 244, -40, 21, -12, 7, -3},  
  { 0, 1, -2, 5, -12, 32, 253, -30, 15, -9, 5, -2},  
  { 0, 0, -1, 3, -6, 15, 256, -16, 8, -5, 3, -1}}
```

```
ecmFilter - proposedBiPredFilter = {  
  { 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},  
  { 0, -1, 2, -2, 2, -2, 1, -1, 1, -1, 1, 0},  
  { 1, -2, 2, -3, 4, -4, 3, -3, 3, -2, 1, 0},  
  { 1, -2, 3, -4, 4, -3, 4, -4, 3, -2, 1, -1},  
  { 1, -3, 4, -4, 5, -5, 4, -4, 3, -2, 2, -1},  
  { 1, -3, 3, -4, 5, -4, 4, -4, 3, -2, 1, 0},  
  { 1, -1, 2, -3, 3, -4, 3, -3, 3, -2, 1, 0},  
  { 0, -1, 1, -1, 2, -2, 1, -1, 2, -1, 1, -1},  
  { 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},  
  { -1, 1, -1, 2, -1, 1, -2, 2, -1, 1, -1, 0},  
  { 0, 1, -2, 3, -3, 3, -4, 3, -3, 2, -1, 1},  
  { 0, 1, -2, 3, -4, 4, -4, 5, -4, 3, -3, 1},  
  { -1, 2, -2, 3, -4, 4, -5, 5, -4, 4, -3, 1},  
  { -1, 1, -2, 3, -4, 4, -3, 4, -4, 3, -2, 1},  
  { 0, 1, -2, 3, -3, 3, -4, 4, -3, 2, -2, 1},  
  { 0, 1, -1, 1, -1, 1, -2, 2, -2, 2, -1, 0}}
```

Example filter response



Results

	Random Access					
	Over ECM-12.0					
	Y	U	V	EncT	DecT	VmPeak
Class A1	-0.05%	0.00%	-0.12%	101.6%	101.4%	100.0%
Class A2	0.01%	0.00%	-0.12%	98.1%	98.6%	99.7%
Class B	-0.07%	-0.03%	0.03%	99.2%	99.7%	100.0%
Class C	-0.15%	-0.07%	-0.03%	99.9%	100.2%	100.0%
Class E						
Overall	-0.07%	-0.03%	-0.05%	99.7%	99.9%	99.9%
Class D	-0.35%	-0.41%	-0.28%	101.0%	102.2%	99.9%
Class F	-0.05%	-0.03%	-0.17%	99.0%	99.6%	99.4%
Class TGM	-0.05%	-0.02%	-0.07%	99.3%	99.4%	99.7%

	Low delay B					
	Over ECM-12.0					
	Y	U	V	EncT	DecT	VmPeak
Class A1						
Class A2						
Class B	-0.08%	-0.16%	-0.34%	101.2%	100.5%	100.0%
Class C	-0.11%	-0.30%	-0.12%	100.0%	98.9%	98.9%
Class E	-0.02%	-0.17%	-0.83%	96.2%	97.8%	99.9%
Overall	-0.07%	-0.21%	-0.39%	99.6%	99.3%	99.6%
Class D	-0.06%	-0.27%	0.29%	101.7%	100.9%	100.6%
Class F	0.11%	-0.42%	-0.24%	95.9%	96.9%	98.1%
Class TGM	-0.09%	-0.20%	-0.06%	96.9%	97.6%	101.3%

Proposal summary

1. Proposal to define a new motion compensation filter to be used for bi-prediction.
2. A 12-tap cos-windowed sinc filter with sharper filter properties is proposed, applied for luma bi-prediction only.
3. Average BD-Rate(PSNR-Y/U/V) impact of -0.07%/-0.03%/-0.05% for RA and -0.07%/-0.21%/-0.39% for LDB with no encoder or decoder time impact.
4. Proposed to be tested in the next round of EEs.

Thank you Lienfei (Tencent) for cross-checking (JVET-AH0329)!



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