

Adaptive Loop Filtering using Directional Activity

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Overview

- Adaptive Loop Filtering using Directional Activity (ALF-DA)
 - Y BD-bitrate -0.32%(LD/HE) -0.39%(RA/HE)
- 9 encoding-passes
 - Reduced from 16 passes in QC-ALF
- The number of encoding-pass is reduced without sacrificing coding performance.

Introduction

- QC-ALF in HM2.0
 - Wiener filter based on only activity
(= No consideration to activity directions)
 - 16 categories (= 16 encoding passes)
- QC-ALF is inappropriate for edge texture
 - Typical content has various directions of edge

Motivation & Solution

- Motivation
 - Reduce the number of encoding passes
 - Consider activity with edge direction
 - Derive more precise filter coefficients
- Solution
 - Adaptive loop filtering based on vertical activity and horizontal activity

Proposed method 1/2

- Laplacian operator

$$H_{i,j} = (x_{i+1,j-1} + 2x_{i+1,j} + x_{i+1,j+1}) - (x_{i-1,j-1} + 2x_{i-1,j} + x_{i-1,j+1})$$

$$V_{i,j} = (x_{i-1,j+1} + 2x_{i,j+1} + x_{i+1,j+1}) - (x_{i-1,j-1} + 2x_{i,j-1} + x_{i+1,j-1})$$

- Activity evaluation

- Calculated such as $H^A = \sum_{-R \leq i+j \leq R} |H_{i,j}|$, $V^A = \sum_{-R \leq i+j \leq R} |V_{i,j}|$

- Scaled into [0, 15], similar to QC-ALF

- Categorized into **N x N cases**

- Derive Wiener filter for each cases

Proposed method 2/2

- In this contribution, $N=3$
 - Thresholds are 2 and 7
- Categorization

Activity combination		Horizontal activity H^A		
		$H^A \leq 2$	$2 < H^A \leq 7$	$7 < H^A$
Vertical activity V^A	$H^V \leq 2$	case 0	case 1	case 2
	$2 < H^V \leq 7$	case 3	case 4	case 5
	$7 < H^V$	case 6	case 7	case 8

Experimental Results

- Integration to HM2.0
- Summary of the results for LD/HE and RA/HE

	LD/HE
	Y BD-rate
Class A	
Class B	-0.39
Class C	-0.11
Class D	-0.19
Class E	-0.64
All	-0.32
Enc Time[%]	103%
Dec Time[%]	110%

	RA/HE
	Y BD-rate
Class A	-0.4
Class B	-0.64
Class C	-0.23
Class D	-0.21
Class E	
All	-0.39
Enc Time[%]	103%
Dec Time[%]	110%

Conclusion

- Adaptive loop filtering using directional activity (ALF-DA)
 - Y BD-bitrate -0.32%(LD/HE) -0.39%(RA/HE)
- 9 encoding passes
 - Reduced from 16 passes in QC-ALF
- Propose to adopt ALF-DA into CE for further study and improvement by all experts