

# JCTVC-G497

## **SIMD optimization of proposed HEVC core transforms**

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# Summary

- Stand-alone test program with inverse transforms
- Optimized SIMD implementation for Intel Sandy Bridge
- Full and partial transforms
- Combined with transform usage statistics from HM3.0
- Estimated CPU load from inverse transforms alone

# Optimization procedure

- Automated tool from SpiralGen Inc.
- First step (manual):  
Transform description in formal mathematical language
- Second step (automatd):  
Apply transform description to automated tool

# Column-row order (HM3.0)

Fast	Faster
Inverse zig-zag scan	Inverse zig-zag scan
Transformation of columns	Transformation of columns
	Transpose
Transformation of rows	Transformation of columns
	Transpose

# Row-column order

Fast	Faster	Fastest
Inverse zig-zag scan	Inverse zig-zag scan	Inverse zig-zag scan + transpose
	Transpose	
Transformation of rows	Transformation of columns	Transformation of columns
	Transpose	Transpose
Transformation of columns	Transformation of columns	Transformation of columns

# Partial transforms

- Full transform size:  $N \times N$
- Partial transform:  
 $K \times K$  low frequency sub-block is non-zero

# Estimated cycle counts per 2D transform (Intel i7 Sandy Bridge, SSE4, Windows, 64-bit)

NxN	KxK	Column-row order	Row-column order
8x8	8x8	167	152
8x8	4x4	108	78
16x16	16x16	943	859
16x16	8x8	547	467
16x16	4x4	304	233
32x32	32x32	5720	5322
32x32	16x16	2764	2442
32x32	8x8	1732	1405
32x32	4x4	1167	836

# Estimated cycle counts per 2D transform (Intel i7 Sandy Bridge, Linux, 64-bit)

NxN	KxK	SSE4	AVX
8x8	8x8	138	123
16x16	16x16	836	708
32x32	32x32	5329	4556



# CPU load for Intel 3.5 GHz

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# CPU load for Intel 3.5 GHz

Sequence	Bitrate (kbps)	CPU load	Bitrate (kbps)	CPU load
	QP=37		QP=22	
Kimono	560	0,6%	5325	2,5%
ParkScene	590	0,3%	8221	1,1%
Cactus	1308	0,8%	19693	3,9%
BasketballDrive	1572	1,2%	20049	5,6%
BQTerrace	799	0,4%	50211	4,6%

# Conclusion

- Optimized implementation of HM4.0 transforms
- Exploiting partial transforms
- Statistics from HM3.0 bitstreams
- Typical CPU load for 1080p decoding: 0.3% - 5,6%