



# Selective Motion Estimation Strategy Based on Content Classification for HEVC Screen Content Coding

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# Screen Content Videos

Camera-captured content

The image displays a collage of screenshots from a camera-captured screen recording. The top left shows the Tongji University website with a red circle around the 'About Tongji' section. The bottom left shows a webpage for 'High Efficiency Video Coding' with a red circle around the 'MPEG High Efficiency Video Coding (HEVC)' section. The center features a video player showing a basketball game and a cat. The right side shows a MATLAB R2013a interface with a Command Window displaying code and a 3D surface plot. A red arrow points from the website to the MATLAB interface.

**Tongji University Website Screenshot:**

- Home | News & Events | About Tongji | Faculty | Academics | Admissions | Research | Alumni | Services | Employment
- About Tongji
  - Introduction to tongji
  - Welcome
  - Campus Maps
  - History of Tongji University
  - Chronology
  - Former presidents
  - Campus Scenery
  - Services and Administrations

**High Efficiency Video Coding Screenshot:**

**High Efficiency Video Coding**

Standard: H.264

Part number: 2

Activity status: Open

Technologies: 2.1, video coding

The overall amount of video data rate that is to be transferred over networks will continue to increase, driven by the increased number of services and users and the increasing video from SD to HD and beyond.

HEVC is the new generation of video compression technology with higher compression efficiency than H.264/AVC.

HEVC supports all commonly used progressive scan picture formats, ranging at least from 320x240 to Ultra HD resolutions such as 8Kx4K, as well as picture formats of arbitrary aspect ratio.

MPEG doc# N11922

Date: January 2011

**MPEG High Efficiency Video Coding (HEVC)**

**Video Player Screenshot:**

832x480@50Hz: 501 frames: 0'22'02.286: 286.216MB

**MATLAB R2013a Screenshot:**

```
1 % Create a 3D surface plot of a function.
2 K1 = linspace(1,25);
3 K2 = linspace(2,25);
4 K3 = linspace(3,25);
5 K4 = linspace(4,25);
6 K5 = linspace(5,25);
7 I1 = [K1; 25+K1; K2+26+K1];
8 I2 = [K2; 25+K2; K3+26+K2];
9 I3 = [K3; 25+K3; K4+26+K3];
10 I4 = [K4; 25+K4; K5+26+K4];
11 I = [I1; I2; I3; I4];
12 I(Visible) = true;
13
14 m = mpr('9.439728445_15-19755192_2pg1', 2pg1');
15
16 n = 100;
17 weight = 0.5;
18 close all;
19 hold on;
20 mesh(I);
21 title('logLogFig, oncol', 'L', 'R', '3');
22
23 end
24 set(LogLogFig, 'type', 'surf', 'log', 'thetaAxisVisible', 'off');
25
26 % Find the minimum value of the function.
27 [minVal, minLoc] = min(I(:));
28
29 % Draw the surface plot.
30 for i = 1:100
31     S = mesh(I(1+K1:i+K1, :));
32     S = mesh(I(1+K1:i+K1, :));
33     S = mesh(I(1+K1:i+K1, :));
34     S = mesh(I(1+K1:i+K1, :));
35 end
36
37 % Draw the surface plot.
38 for i = 1:100
39     S = mesh(I(1+K1:i+K1, :));
40     S = mesh(I(1+K1:i+K1, :));
41     S = mesh(I(1+K1:i+K1, :));
42     S = mesh(I(1+K1:i+K1, :));
43 end
```

# TZ Search(TZS) vs. TZ Search Selective(TZSS)

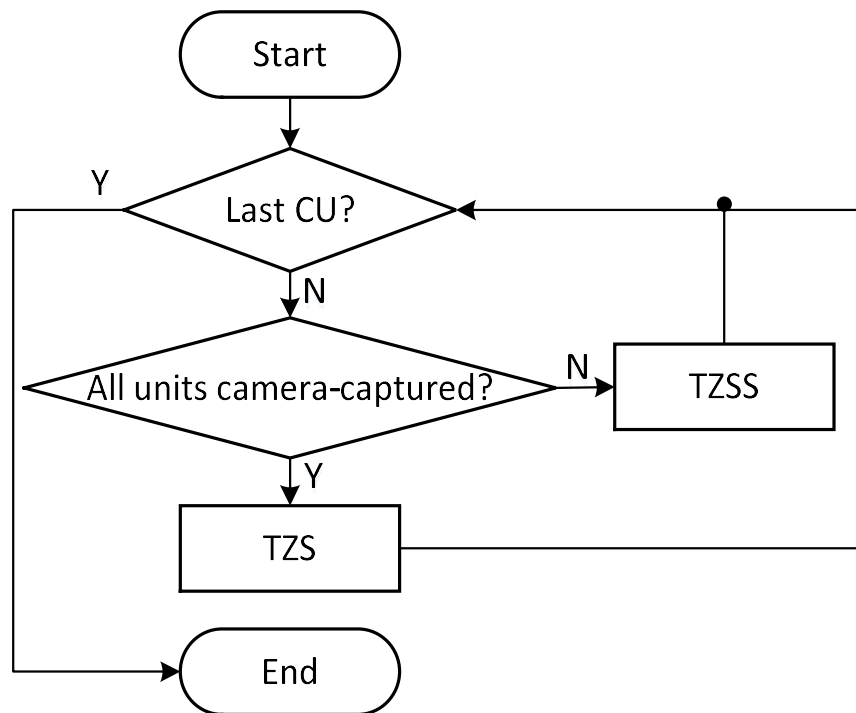
Compared with TZSS:

- TZS consumes less encoding time.
- For camera-captured content, TZS hardly brings any encoding efficiency degradation.

Table 1. TZS Compared with TZSS (32 frames, low delay, various QPs)

Sequences		Y/G BD-rate (%)		Enc time saving (%)	
		YUV444	RGB	YUV444	RGB
Pure Screen Content	<i>sc_flyingGraphics</i>	2.92	2.84	34	30
	<i>sc_desktop</i>	2.45	2.65	22	20
	<i>sc_console</i>	6.44	4.39	30	24
Pure Camera-captured Content	<i>EBURainFruits</i>	0.04	-0.01	25	21
	<i>Kimono1</i>	-0.22	0.06	39	30

# Selective Motion Estimation Strategy



Since TZS is better than TZSS for camera-captured content, the HM-SCC encoder can speed up by applying an adaptively selective motion estimation strategy. For each screen content inter frame, it is firstly classified into screen content areas and camera-captured areas. Then, the camera-captured CUs (Coding Unit) and the screen content CUs will be adaptively switched between TZS and TZSS motion estimation method.

# CU Content Classification

The screenshot shows a computer desktop with a video player on the left and a web browser on the right. The browser displays the 'JCT-VC DOCUMENT MANAGEMENT SYSTEM' website. The website has a search bar and a table of documents. A red box highlights a portion of the table, and a red circle highlights a clock icon on the page.

JCT-VC number	MPEG number	Created	First upload	Last upload	Title	Source	Download
JCTVC-0005	m31066	2013-10-15 14:09:41			JCT-VC AHG report: HEVC range extensions development (AHG5)	M. Naccari, C. Rosewarne	
JCTVC-0010	m30008	2013-10-14 18:33:31			JCT-VC AHG report: SHVC core experiments (AHG10)	X. Li, J. Boyce, P. Onno, X. Xiu	
JCTVC-0012	m30070	2013-10-14 23:30:56			JCT-VC AHG report: SHVC software development (AHG12)	V. Szelep, Y. He, T.-D. Chang, D.-K. Kwon	
JCTVC-0032	m30040	2013-10-14 20:29:56			SCE2 Summary Report	Mathias Wien, Krishna Rajeev, Xiaoyu Xiu	
JCTVC-0038	m31066	2013-10-15 14:12:56			RCE2: Summary report on HEVC Range Extensions Core Experiment 2 (RCE2) on Rice parameter initialization and update methods	C. Rosewarne, J. Sola, K. Sharma, S.-H. Kim	
JCTVC-0037	m30942	2013-10-14 20:33:40			RCE3: Summary report of HEVC Range Extensions Core Experiment 3 on Intra Prediction techniques	A. Saxena, D. Kwon, M. Naccari, C. Pang	
JCTVC-0041	m30749	2013-09-19 14:48:30	2013-08-19 15:00:02	2013-08-19 15:00:02	REXT/MV-HEVDSHVC HLS: auxiliary picture layers	M. M. Haruhusala (Nokia)	JCTVC-00041
JCTVC-0042	m30761	2013-09-27 22:34:38			Proposed Editorial Improvements to High efficiency video coding (HEVC) Range Extensions: Text Specification Draft 4	D. Flynn	
JCTVC-0043	m30762	2013-09-27 22:36:25	2013-10-10 01:41:28	2013-10-15 01:41:28	Best-effort decoding of 10-bit sequences	D. Flynn	JCTVC-00043
JCTVC-0044	m30763	2013-09-27 22:37:42	2013-10-15 06:32:45	2013-10-15 06:32:45	RExt: CU-adaptive chroma QP offsets	D. Flynn, N. Naveen, D. He, G. Martin Cocher (BlackBerry), akourap@apple.com, G. Cote, D. Singer (Acacia)	
JCTVC-0045	m30764	2013-09-27 22:39:52	2013-10-15 06:32:59	2013-10-15 06:32:59	RExt: minimum chroma TU size restriction for low-fidelity coding mode	D. Flynn, N. Naveen, D. He (BlackBerry)	
JCTVC-0046	m30766	2013-10-03 17:09:30	2013-10-03 17:18:55	2013-10-03 17:18:55	AHG5 and AHG10: Entropy Coding Throughput for High Bit Depths	K. Sharma, N. Saunders, J. Ganel (Sony)	
JCTVC-0047	m30767	2013-10-07 06:28:31	2013-10-14 23:42:44	2013-10-14 23:42:44	RCE 3: On sample adaptive intra prediction for oblique modes in lossless coding	H. Chen, A. Saxena, F. Fernandes (Samsung)	
JCTVC-0048	m30768	2013-10-07 06:27:28	2013-10-16 00:13:33	2013-10-16 00:13:33	RCE 3: On sample adaptive intra prediction for oblique modes in lossy coding	A. Saxena, H. Chen, F. Fernandes (Samsung)	
JCTVC-0049	m30769	2013-10-07 05:28:38	2013-10-16 05:53:08	2013-10-16 05:53:08	RCE 3: Nearest-neighbor intra prediction for screen content video coding	H. Chen, A. Saxena, F. Fernandes (Samsung)	
JCTVC-0050	m30760	2013-10-07 06:29:30			RCE 3: Cross-Check of Tool A.1 from Fujitsu	A. Saxena, F. Fernandes (Samsung)	
JCTVC-0051	m30761	2013-10-07 07:21:08	2013-10-15 23:48:36	2013-10-15 23:48:36	RCE 3: Combination of sample adaptive prediction and nearest neighbor prediction for oblique modes	A. Saxena, H. Chen, F. Fernandes (Samsung)	JCTVC-00051
JCTVC-0052	m30764	2013-10-10 01:33:37	2013-10-10 06:49:09	2013-10-10 06:49:09	SCE1: Results of Test 1.2 on selection of fixed filters for upsampling	K. Mroo, D. Bayon (ARRIS)	JCTVC-00052
JCTVC-0053	m30766	2013-10-10 06:05:28	2013-10-16 06:43:15	2013-10-16 06:43:15	RExt: On transform selection for Intra-BlockCopy blocks	A. Saxena, E. Alshina, F. Fernandes (Samsung)	JCTVC-00053
JCTVC-0054	m30775	2013-10-11 02:17:27	2013-10-15 05:04:07	2013-10-15 05:04:07	Editors' proposed corrections to HEVC version 1	V.-K. Wang, G.-J. Sullivan, B. Bross	JCTVC-00054
JCTVC-0055	m30776	2013-10-11 10:01:24	2013-10-11 10:41:14	2013-10-11 10:41:14	MV-HEVDSHVC HLS: Shipped slice and use case	T. Yamamoto, T. Imai, T. Tsukuba (Sharp)	JCTVC-00055
JCTVC-0056	m30777	2013-10-11 10:01:27	2013-10-11 10:44:13	2013-10-11 10:44:13	MV-HEVDSHVC HLS: On conversion to ROI-capable multi-layer bitstream	T. Yamamoto, T. Imai, T. Tsukuba (Sharp)	JCTVC-00056
JCTVC-0057	m30778	2013-10-11 10:01:28	2013-10-11 03:34:24	2013-10-11 03:34:24	MV-HEVDSHVC HLS: On support of different luma CTS sizes for different layers	T. Yamamoto, T. Imai, T. Tsukuba (Sharp)	JCTVC-00057
JCTVC-0058	m30779	2013-10-11 10:01:33	2013-10-16 08:13:30	2013-10-16 08:13:30	MV-HEVDSHVC HLS: On profile, tier, and level information	T. Tsukuba, T. Imai, T. Yamamoto (Sharp)	JCTVC-00058

denotes camera-captured areas.

# Experimental Results

Table 2. Lowdelay configuration

Sequences	Y/G BD-rate (%)		Encoding Time Saving (%)	
	YUV444	RGB	YUV444	RGB
<i>sc_flyingGraphics</i>	0.01	0.21	0	-1
<i>sc_desktop</i>	0.01	0.01	-1	-1
<i>sc_console</i>	0.00	0.00	-1	0
<i>sc_web_browsing</i>	0.07	0.24	4	4
<i>sc_map</i>	0.51	0.34	31	26
<i>sc_programming</i>	0.28	0.06	15	12
<i>sc_SlideShow</i>	0.61	0.47	21	17
<i>Basketball_Screen</i>	0.23	0.42	28	22
<i>MissionControlClip2</i>	0.21	0.14	17	16
<i>MissionControlClip3</i>	0.27	0.28	13	13
<i>sc_robot</i>	0.43	0.41	32	29
<i>EBURainFruits</i>	0.05	0.03	16	13
<i>Kimono1</i>	0.00	-0.05	39	25
Average	0.20		15	

Table 3. Random Access configuration

Sequences	Y/G BD-rate (%)		Encoding Time Saving (%)	
	YUV444	RGB	YUV444	RGB
<i>sc_flyingGraphics</i>	0.24	0.06	-1	0
<i>sc_desktop</i>	0.00	-0.01	14	11
<i>sc_console</i>	0.00	0.00	3	4
<i>sc_web_browsing</i>	0.00	-0.03	0	-1
<i>sc_map</i>	0.22	0.20	14	10
<i>sc_programming</i>	0.12	0.09	18	17
<i>sc_SlideShow</i>	0.23	0.46	25	23
<i>Basketball_Screen</i>	0.14	0.15	16	17
<i>MissionControlClip2</i>	0.04	0.01	10	10
<i>MissionControlClip3</i>	0.07	0.07	9	9
<i>sc_robot</i>	0.34	0.38	26	21
<i>EBURainFruits</i>	0.02	0.07	14	12
<i>Kimono1</i>	0.08	0.20	32	21
Average	0.12		13	

Thanks!