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Title: Motion compensated prediction with 1/8-pel displacement vector resolution

Purpose: Proposal

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1 Abstract

This document shows the coding efficiency of the motion compensated prediction with a displacement vector resolution of 1/8-pel [2] in the current KTA reference model [1]. This technique was already proposed in several former contributions [3][4] and it was already incorporated in former versions of the reference software of H.264/AVC until version JM43a [5]. The experimental results show a bit rate reduction of 3-14% compared to the KTA reference model at 36dB Y-PSNR.

2 Motion compensated prediction with 1/8-pel displacement vector resolution

In the KTA reference model [1], the temporal redundancy is reduced by the use of predictive coding. In order to predict the current image signal, a prediction image signal is obtained from already reconstructed images by using block based motion estimation and motion compensated prediction. For each block to be coded, a displacement vector is assigned referring to a reference block in an already transmitted image. The prediction error signal and the displacement vector are encoded and transmitted. Currently, the displacement vector has a resolution of 1/4-pel. In this contribution, we propose to increase the resolution of the displacement vector from 1/4-pel to 1/8-pel. This has already been proposed in several former

contributions such as [3][4] and it has already been incorporated in the reference software of H.264/AVC until version JM43a [5]. In order to interpolate the reference image at sub-pel positions, the following filters are applied. In the case that the adaptive interpolation filters are disabled, the same interpolation filters as in JM43a [5] are applied. These are:

- [-3,12,-39,158,158,-39,12,-3]/256 for 1/2-pel positions
- [-3,12,-37,229,71,-21,6,-1]/256 and [-1,6,-21,71,229,-37,12,-3]/256 for 1/4-pel positions
- Bilinear filter for 1/8-pel positions

In the case that the adaptive interpolation filters are enabled, the following interpolation filters are applied:

- Adaptive interpolation filters for 1/2-pel and 1/4-pel positions
- Bilinear filter for 1/8-pel positions

3 Experimental results

For experimental investigations, the motion compensated prediction with 1/8-pel displacement vector resolution is integrated into the current version of the KTA reference model [1]. The following coder settings are applied:

- High Profile
- CABAC
- 5 reference frames
- Frame structure I B B B P with hierarchical B-Pictures
- Adaptive interpolation filters
- Rate-distortion optimization in the “High Complexity Mode”
- Quantization with an adaptive deadzone

In the Figures below, measured operational rate-distortion curves are shown. The following table shows the reduction of the bit rate at 36 dB Y-PSNR for the various tested sequences achieved for both kinds of quantization. It can be seen that the bit rate is reduced by 3-14% by this technique.

Table 1: Achieved bit rate reduction at 36dB Y-PSNR

Sequence	Format	Frame rate [Hz]	Scan	Bit rate reduction [%]
Flowergarden	QCIF	30	progressive	8
Mobile & Calendar	QCIF	30	progressive	14
Tempete	QCIF	30	progressive	6
Flowergarden	CIF	30	progressive	8
Mobile & Calendar	CIF	30	progressive	12
Tempete	CIF	30	progressive	5
City	HDTV (720)	60	progressive	3
Spincalendar	HDTV (720)	60	progressive	3
Vintage Car	HDTV (1080)	30	progressive	3

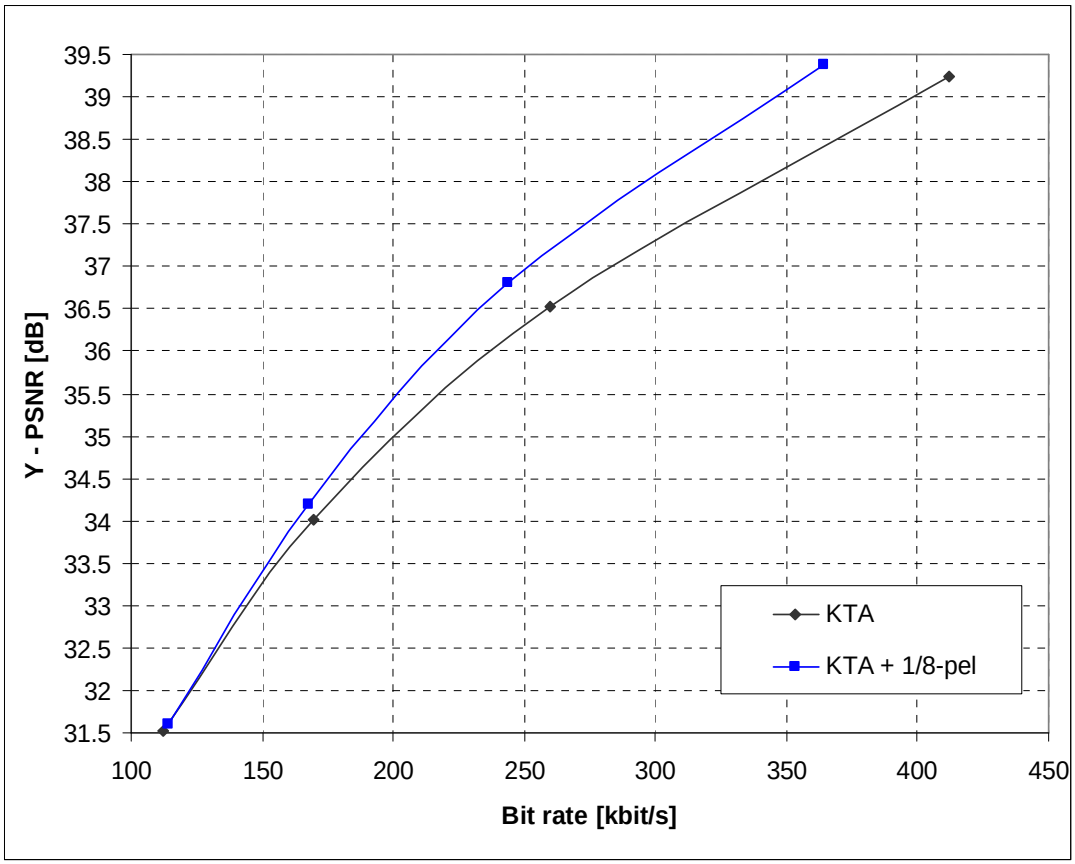

Figure 1: Measured operational rate distortion curves for the test sequence Flowergarden in QCIF, 30Hz.

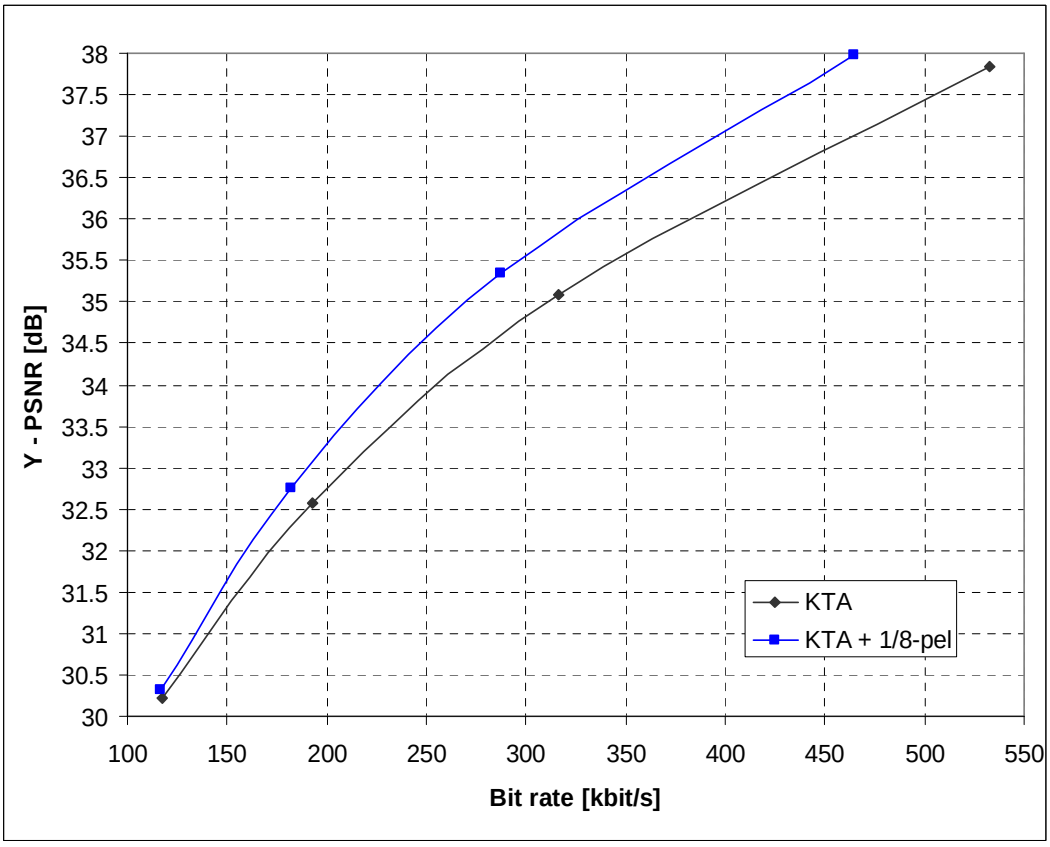

Figure 2: Measured operational rate distortion curves for the test sequence Mobile & Calendar in QCIF, 30Hz.

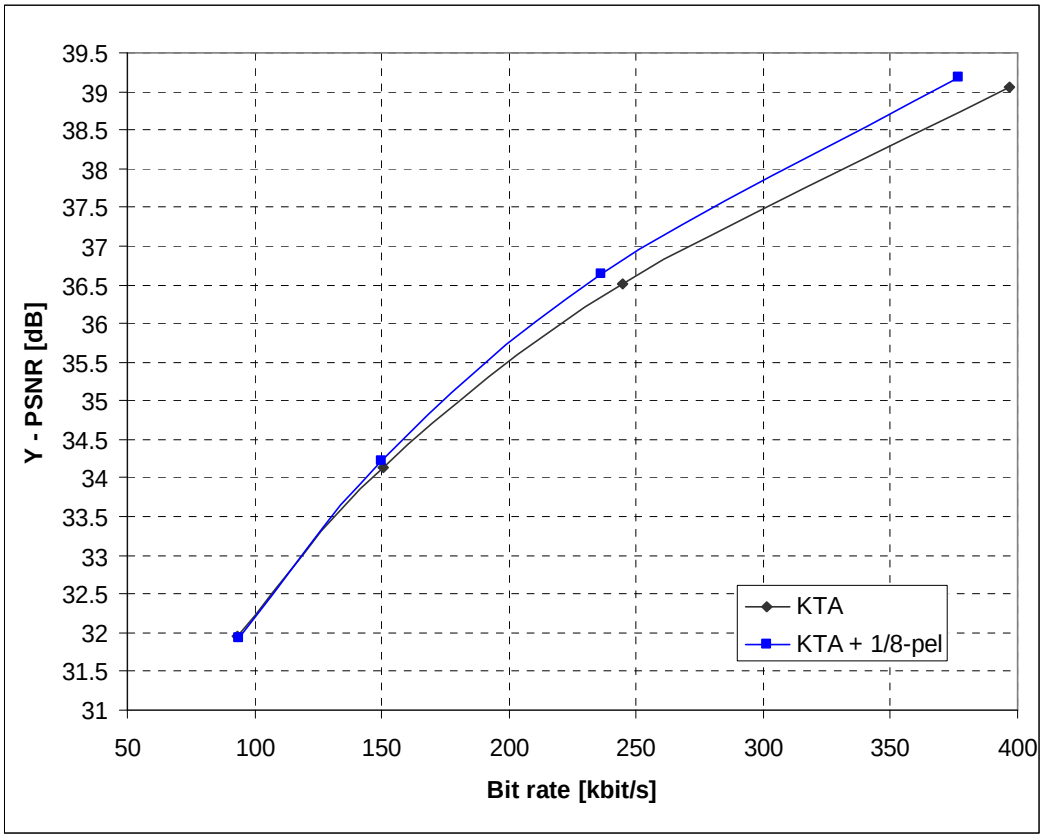

Figure 3: Measured operational rate distortion curves for the test sequence Tempete in QCIF, 30Hz.

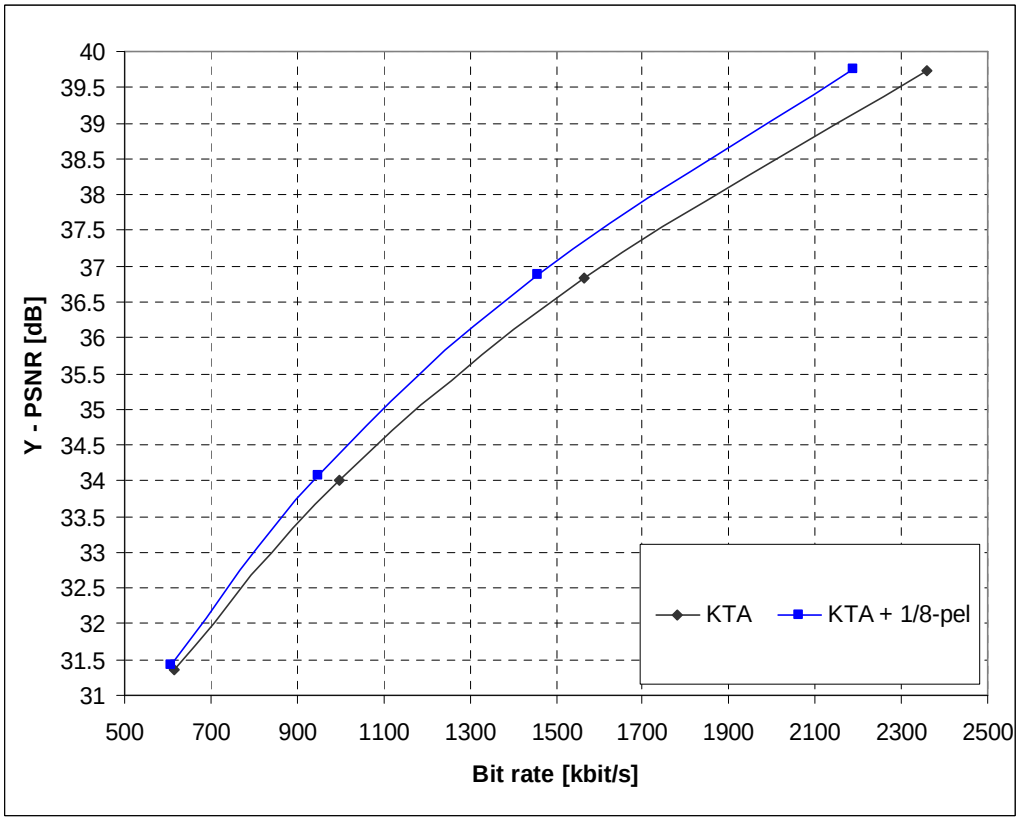

Figure 4: Measured operational rate distortion curves for the test sequence Flowergarden in CIF, 30Hz.

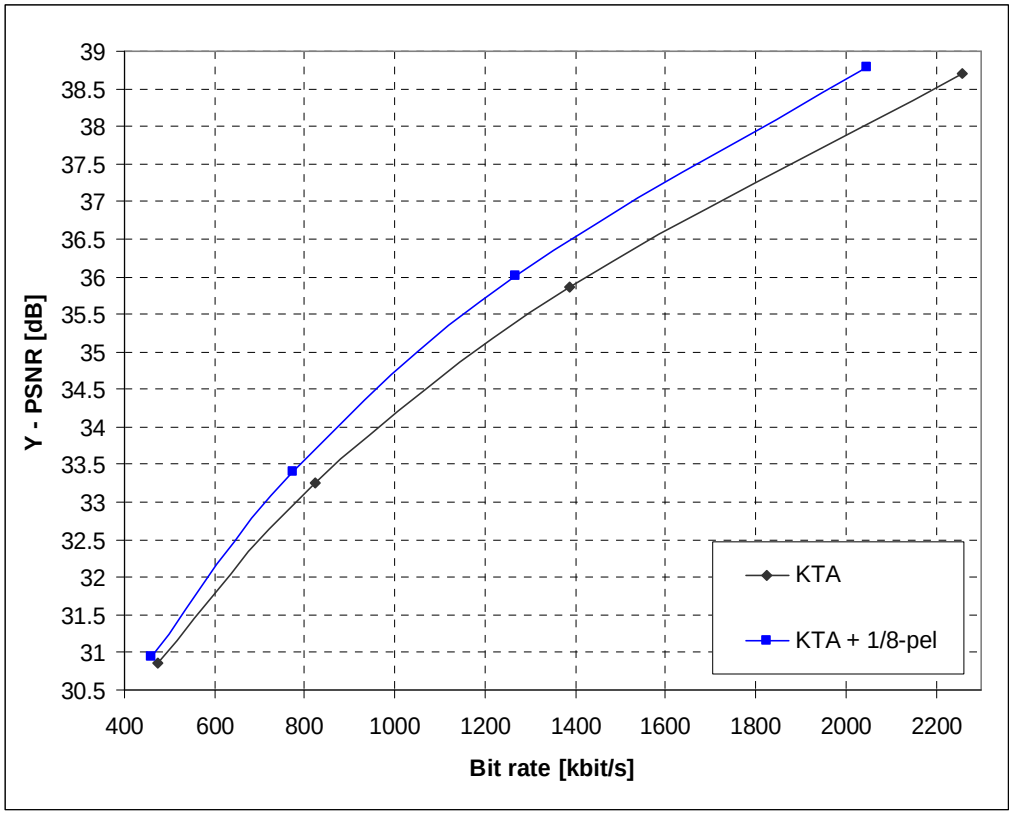

Figure 5: Measured operational rate distortion curves for the test sequence Mobile & Calendar in CIF, 30Hz.

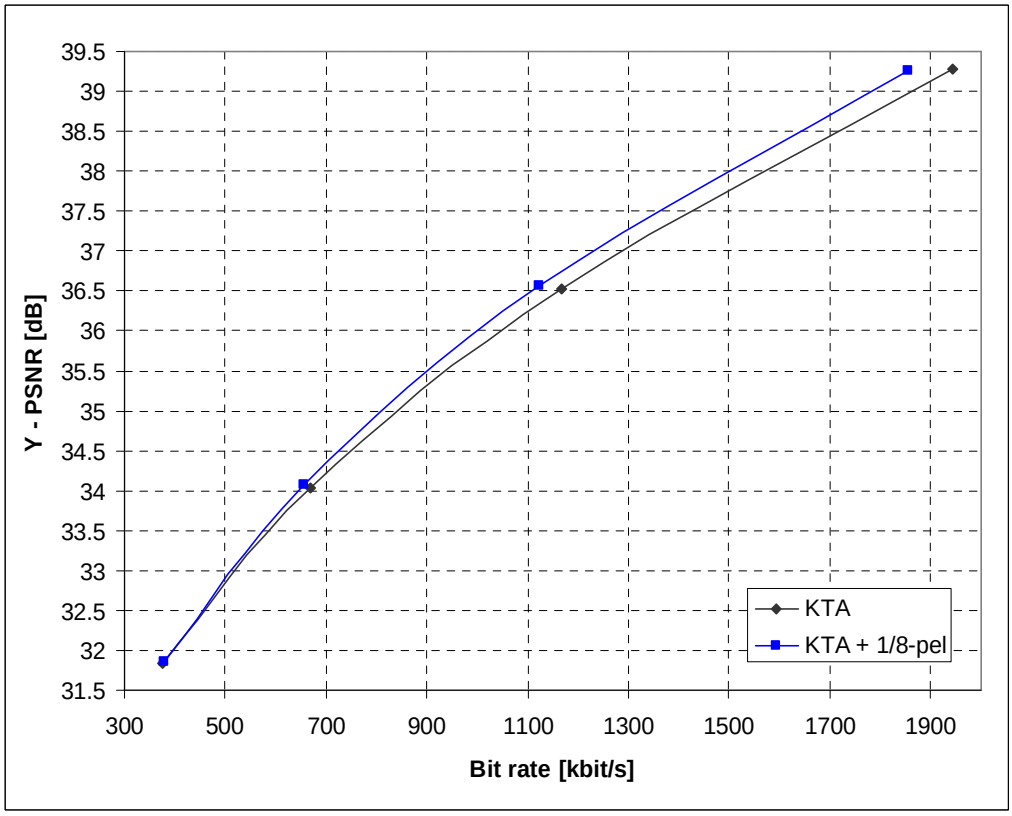

Figure 6: Measured operational rate distortion curves for the test sequence Tempete in CIF, 30Hz.

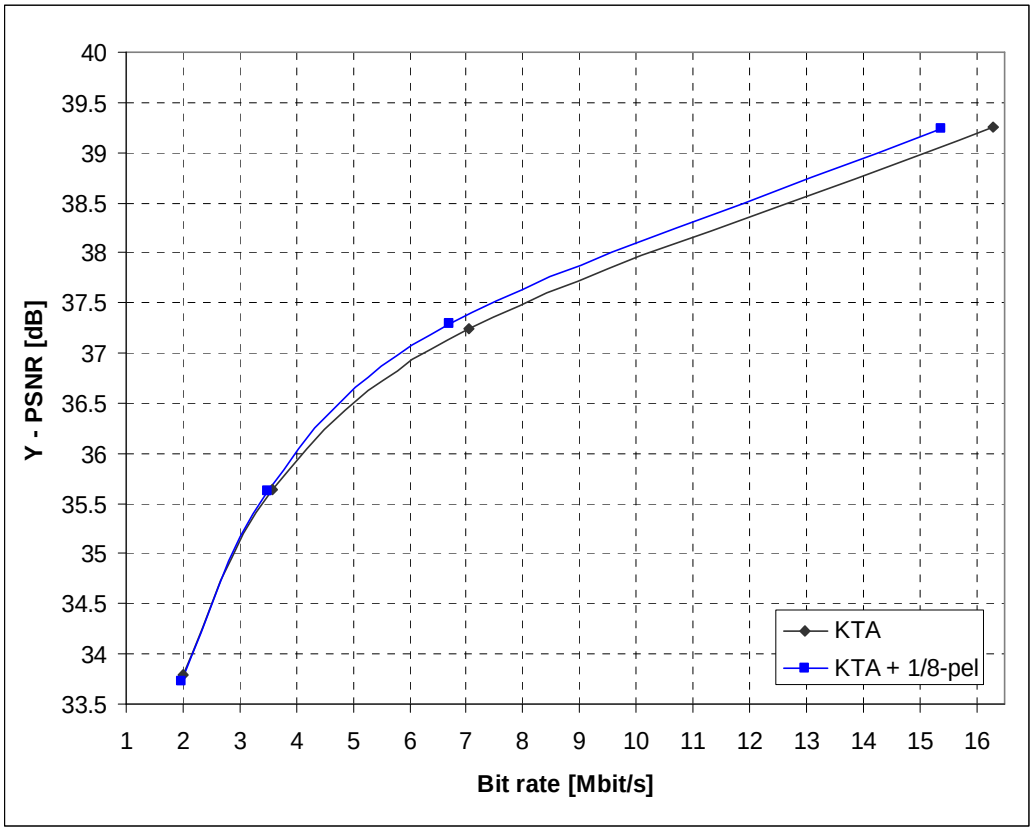

Figure 7: Measured operational rate distortion curves for the test sequence City in HDTV (1280x720), 60Hz.

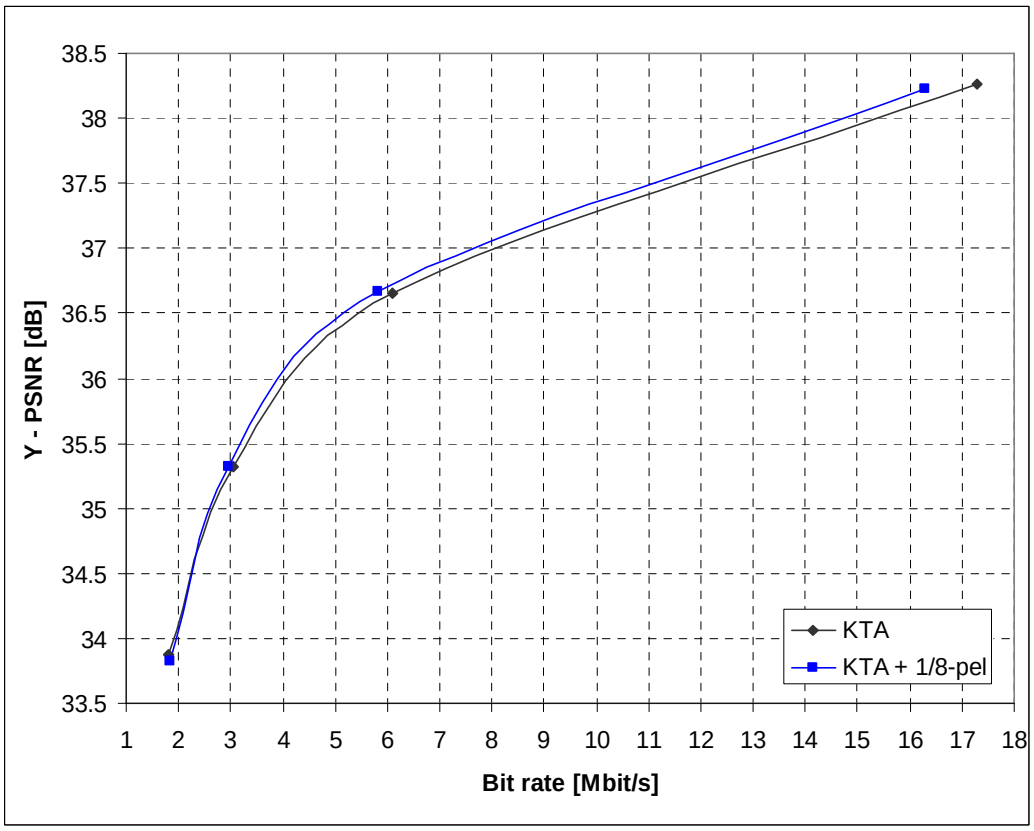

Figure 8: Measured operational rate distortion curves for the test sequence Spincalendar in HDTV (1280x720), 60Hz.

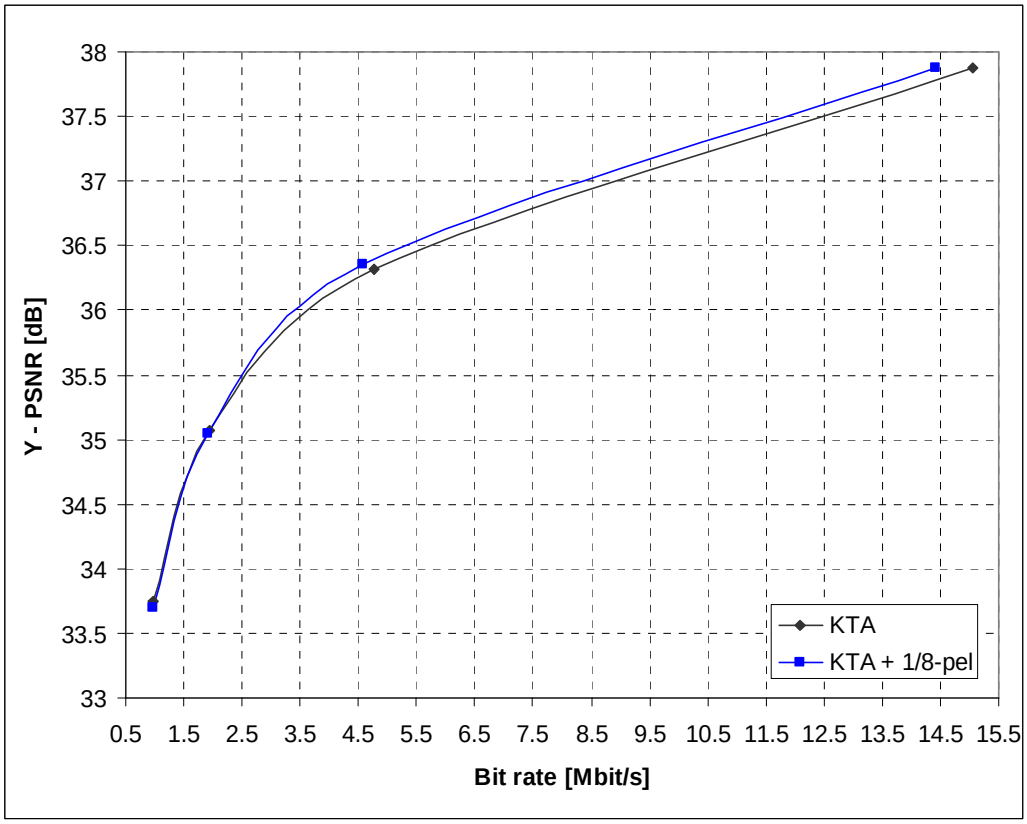

Figure 9: Measured operational rate distortion curves for the test sequence Vintage Car in HDTV (1920x1080), 30Hz.

4 IPR Statement

The Leibniz Universität Hannover may have IPR connected to the proposed method and based on reciprocity the Leibniz Universität Hannover is prepared to grant a license on reasonable and non-discriminatory terms.

5 References

[1] KTA reference model, downloadable at http://iphome.hhi.de/suehring/tml/download/KTA/jm10.1aif.zip

[2] T. Wedi, H.G. Musmann, “Motion- and Aliasing-Compensated Prediction for Hybrid Video Coding”, IEEE Transactions on Circuits and Systems for Video Technology, vol. 13, pp. 577-586, July 2003.

[3] T. Wedi, “1/8-pel Displacement Vector Resolution for Interlaced Video Coding”, Joint Video Team (JVT), doc. JVT-B066, Geneva, CH, Jan. 2002.

[4] T. Wedi, “Advanced Motion Compensated Prediction Methods”, ITU-T Q.6/SG16, doc. VCEG-X10, Palma de Malloca, Spain, Oct. 2004.

[5] Reference software of H.264/AVC, version JM43a, downloadable at http://iphome.hhi.de/suehring/tml/download/old_jm/jm43a.zip