Tests of broadcasting encoded stereo-video streams with embedded error resilience features

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MOBILE3DTV

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Abstract: In this study we compare the results real reception experiments with simulations averaged over 100 trials. We simulate the physical layer of the DVB-H channel using a Simulink model. The simulated channel is Outdoor Residential with max Doppler freq=1 Hz. The coding and transmission parameters are tuned according to a joint source-channel optimization technique developed within the project. In the real experiment, the data is transmitted by a PC-based DVB-H transmission system featuring a DECTEC modulator and received by a PC-connected DVB-H receiver. The Outdoor Residential channel characteristics are modeled by slowly moving the receiver at a pedestrian speed. The results show that the optimized parameters for a given transmission bitrate and channel condition give similar SNRs with the real tests.

Keywords: Mobile 3DTV, H.264/MVC, MPE-FEC, auto-stereoscopic display, usability

Executive Summary

In this study we compare the results real reception experiments with simulations averaged over 100 trials. We simulate the physical layer of the DVB-H channel using a Simulink model. The simulated channel is Outdoor Residential with max Doppler freq=1 Hz. The coding and transmission parameters are tuned according to a joint source-channel optimization technique developed within the project. In the real experiment, the data is transmitted by a PC-based DVB-H transmission system featuring a DECTEC modulator and received by a PC-connected DVB-H receiver. The Outdoor Residential channel characteristics are modeled by slowly moving the receiver at a pedestrian speed. The results show that the optimized parameters for a given transmission bitrate and channel condition give similar SNRs with the real tests.

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1 Experimental setup

1.1 Setup for simulations

The selected channel model for the experiments is Outdoor Residential with max Doppler freq=1 Hz [1]. It represents situation closer to conventional reception of terrestrial using rooftop antenna. The model is implemented in the Simulink environment [2] using the *Multipath Rayleigh Fading Channel* (MRFC) block with the tapped-delay-line delay and gain values are set as specified in the literature [1]. The Doppler spectrum of each tap is also set as specified in the standard.

The block diagram of the DVB-T physical layer simulator is shown in

Figure **1**. In practice, at the receiver side, after guard interval removal and OFDM demodulation, the receiver calculates an estimate of the channel by looking at the pilot carriers. Pilot carriers have modulation parameters known to the receiver, so according to the changes on pilot carriers, the receiver runs a channel estimation parameter. In the available Simulink model, the Pilot Processing Block right after the OFDM receiver block assumes perfect channel knowledge.

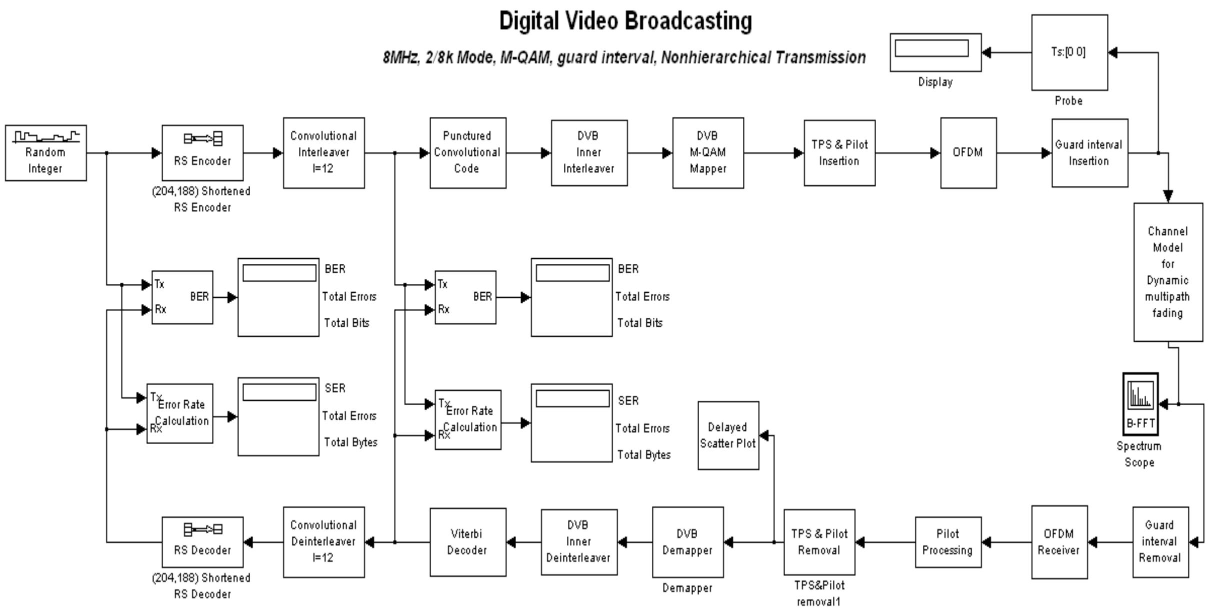

Figure 1: Simulink model for DVB-H physical layer simulation

The chosen transmission mode is given in Table 1. The transmissions have been modeled for SNR=20 dB. More details about the behavior of the chosen model can be found in [3].

Table 1: The chosen DVB-H transmission mode

Bandwidth	8MHz
Modulation	16- QAM
Convolutional rate	2/3
Transmission mode	8k
Guard interval	1/4

Table 2 describes the experimental settings.

Table 2: Test settings

Contents	HeidelbergAlleys, KnightsQuest, RhineValleyMoving, Roller blade
Coding method	MVC
Protection Structure	EEP
Channel SNR Range	20 dB
# of Experiments	100 different error patterns for each transmission

The experiments have been conducted on four different stereo video contents of 432x240 resolution, 12.5 frames per second (fps) and 60 seconds length. Table 3 describes the selected test content.

Table 3: Stereo video test contents

Content	Characteristics
Heidelberg Alleys	Low Motion, High Detail
Knights Quest	Computer Generated
Rhine Valley Moving	High Camera and Object Motion, Low Detail
Roler blade	High Camera and Object Motion, High Detail

The coding and transmission parameters are obtained by using the optimization algorithms described in [5] for the given channel and the results are summarized in Table 4.

Table 4: Optimized coding and protection parameters

Content	QP_left	QP_right	FEC_left	FEC_right
Heidelberg Alleys	27	26	0.65	0.66
Knights Quest	28	26	0.41	0.40
Rhine Valley Moving	27	26	0.65	0.66
Roller blade	27	25	0.78	0.79

1.2 Transmission setup

The data is transmitted by DECTEC modulator [6] connected to a PC. The DVB-H receiver is by Cinergy [7]. The characteristics of the DECTEC modulator and the chosen parameters are given in Table 5. The Outdoor Residential channel model characteristics are mimicked by slowly moving the receiver at a pedestrian speed.

Table 5: Transmitter parameters

Parameter		Value
Modulation		EN 300 744
Bandwidth		5.0…8.0 MHz
Modulation		QPSK, 16/64-QAM
Transmission Mode		2k, 4k, 8k
Convolutional Rate		1/2, 2/3, 3/4, 5/6, 7/8
Guard Interval		1/4, 1/8, 1/16, 1/32
Useful Bit-Rate Range		0…31.7 Mbit/s
RF Output	Connector (2x)	F type, 75 Ω
	Range	400…862 MHz
	Accuracy	≤±1 ppm
	Step Size	100 kHz
	Output Level	-29 ±2 dBm
	Spectral Purity	20dB (d_2); >50dB (oth.)

2 Experimental results

Figures 2-5 and Table 6-9 summarize the results of the real transmission against the simulations for 100 trials in terms of PSNR and SSIM for the four test contents.

In general, the results show that the optimized parameters for a given transmission bitrate and channel condition give similar SNRs with the real tests. The only exception is Knight Quest. The same content proved difficult to process and got also very low ranks in the subjective tests. There might be issues related with too exaggerated disparity in that content which get destroyed during the real transmission.

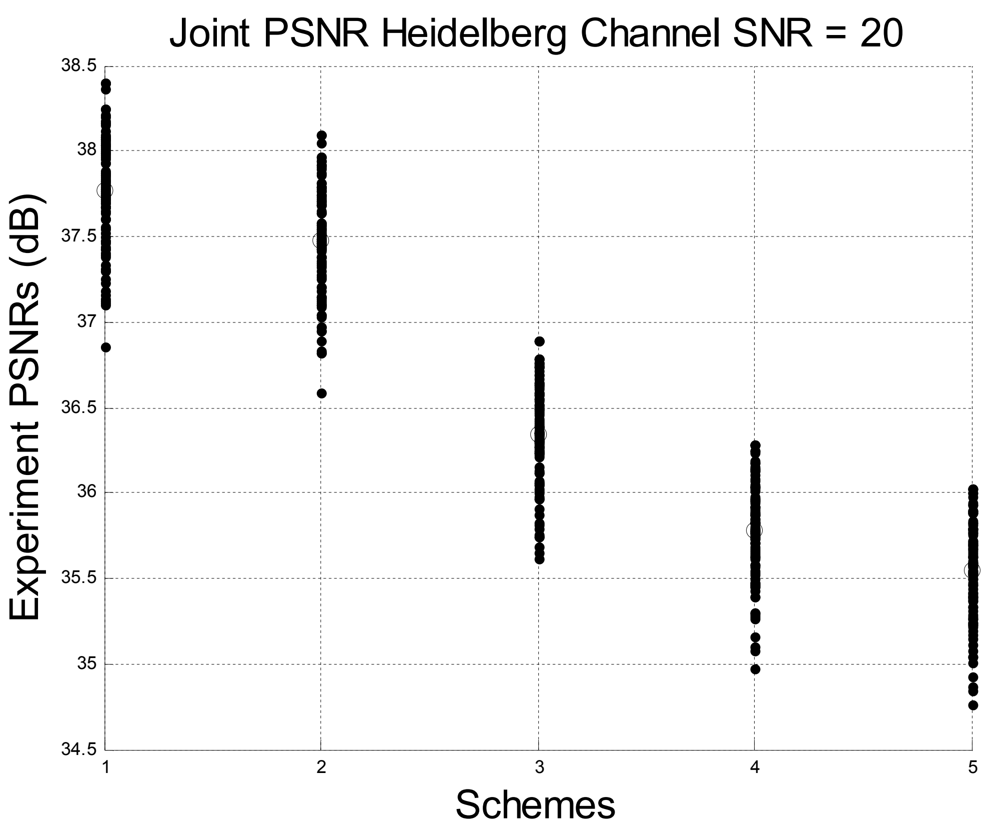

Figure 2: Joint PSNR distribution of 100 simulated experiments at channel SNR 20 dB for five different transmission cases (Heidelberg video)

Table 6: Real reception against simulations (Heidelberg video)

Test Cases		PSNR (dB)			SSIM (0-1)		
		Left	Right	Joint	Left	Right	Joint
Real Reception	27_26_08	37.606	38.380	37.973	0.969	0.973	0.971
	27_27_08	37.852	38.110	37.948	0.970	0.972	0.971
	29_28_08	36.458	37.281	36.845	0.962	0.967	0.964
	29_30_075	36.458	36.025	36.231	0.962	0.960	0.961
	29_31_075	36.458	35.563	35.982	0.962	0.957	0.960
Simulation	27_26_08	37.578	38.134	37.765	0.964	0.964	0.964
	27_27_08	37.578	37.514	37.475	0.964	0.961	0.962
	29_28_08	36.116	36.717	36.340	0.955	0.956	0.955
	29_30_075	36.143	35.548	35.786	0.955	0.950	0.953
	29_31_075	36.143	35.102	35.546	0.955	0.947	0.951

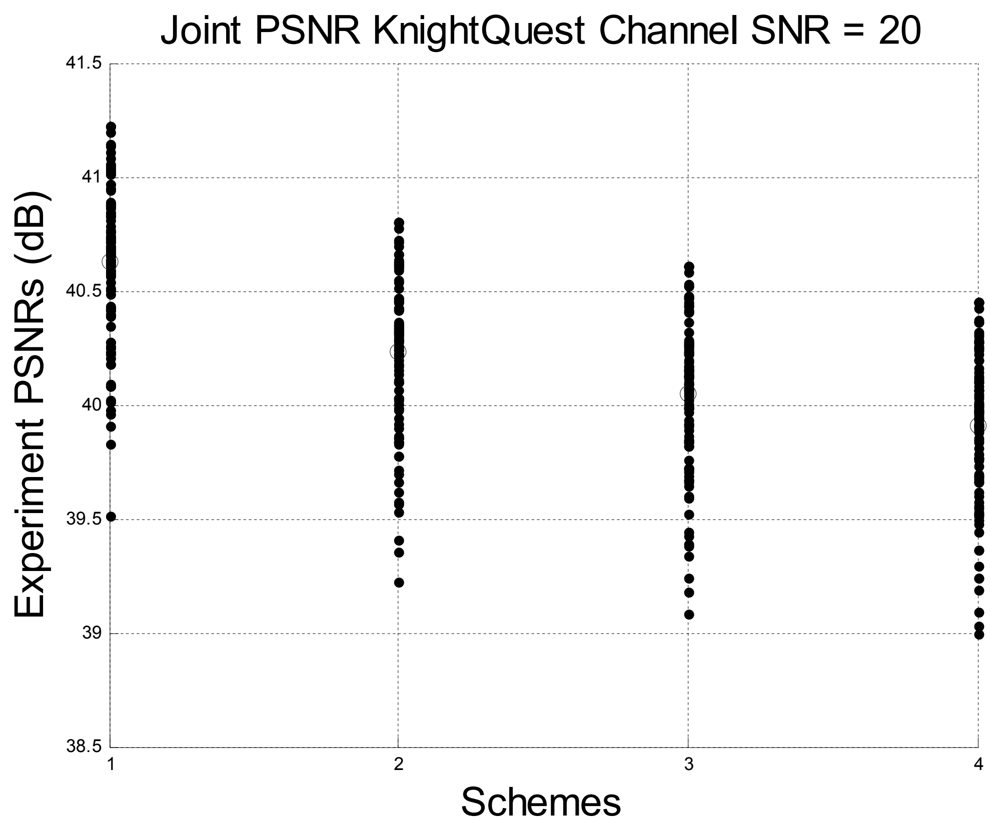

Figure 3: Joint PSNR distribution of 100 simulated experiments at channel SNR 20 dB for five different transmission cases (Knight Quest video)

Table 7: Real reception against simulations (Knight Quest video)

Test Cases		PSNR (dB)			SSIM (0-1)		
		Left	Right	Joint	Left	Right	Joint
Real Reception	28_26_065	24.424	24.489	24.454	0.892	0.896	0.894
	28_28_065	23.953	23.962	23.957	0.870	0.870	0.870
	28_29_065	28.894	28.859	28.876	0.866	0.864	0.865
	28_30_065	28.123	28.101	28.110	0.843	0.841	0.842
Simulation	28_26_065	40.399	41.031	40.627	0.965	0.966	0.965
	28_28_065	40.399	40.189	40.235	0.965	0.962	0.963
	28_29_065	40.399	39.826	40.048	0.965	0.961	0.963
	28_30_065	40.399	39.554	39.909	0.965	0.960	0.962

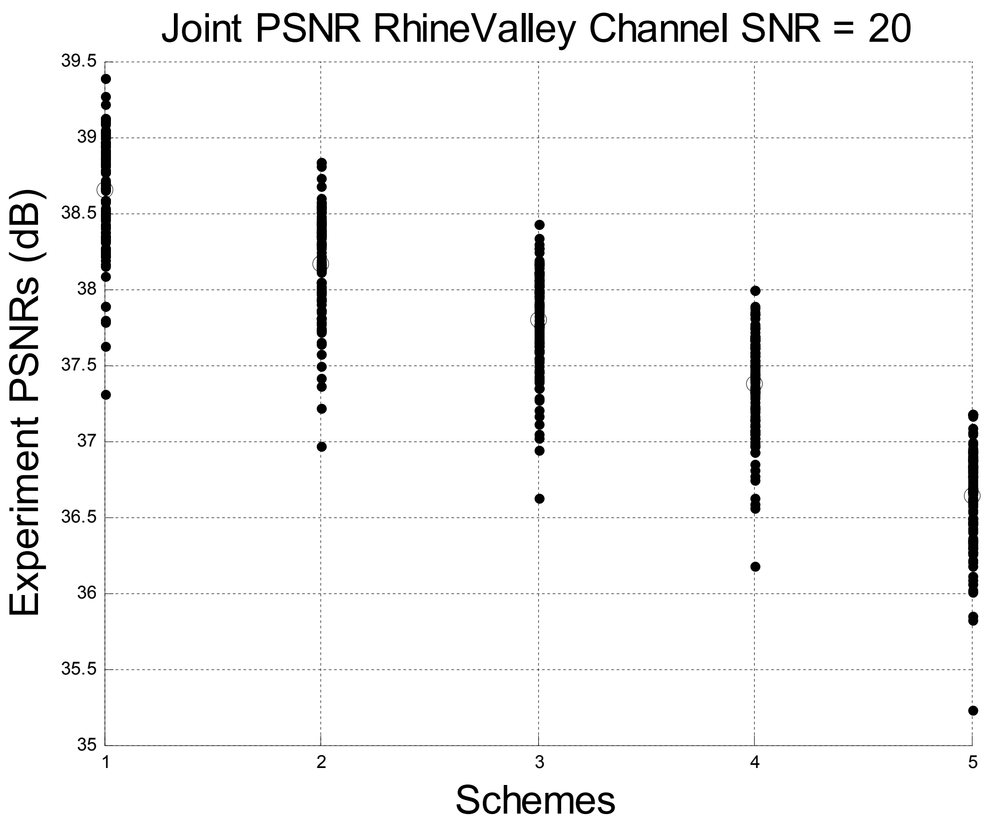

Figure 4: Joint PSNR distribution of 100 simulated experiments at channel SNR 20 dB for five different transmission cases (Rhine Valley video)

Table 8: Real reception against simulations (Rhine Valley video)

Test Cases		PSNR (dB)			SSIM (0-1)		
		Left	Right	Joint	Left	Right	Joint
Real Reception	27_26_08	38.440	39.111	38.757	0.946	0.952	0.949
	27_28_075	38.775	38.380	38.563	0.952	0.950	0.951
	28_28_075	31.315	31.343	31.325	0.933	0.933	0.933
	29_28_075	37.451	37.933	37.600	0.939	0.942	0.941
	29_31_07	37.350	36.409	36.821	0.936	0.926	0.931
Simulation	27_26_08	38.524	38.957	38.650	0.945	0.947	0.946
	27_28_075	38.559	37.933	38.166	0.946	0.939	0.942
	28_28_075	37.918	37.810	37.795	0.939	0.938	0.939
	29_28_075	37.195	37.698	37.369	0.932	0.936	0.934
	29_31_07	37.226	36.204	36.632	0.932	0.921	0.927

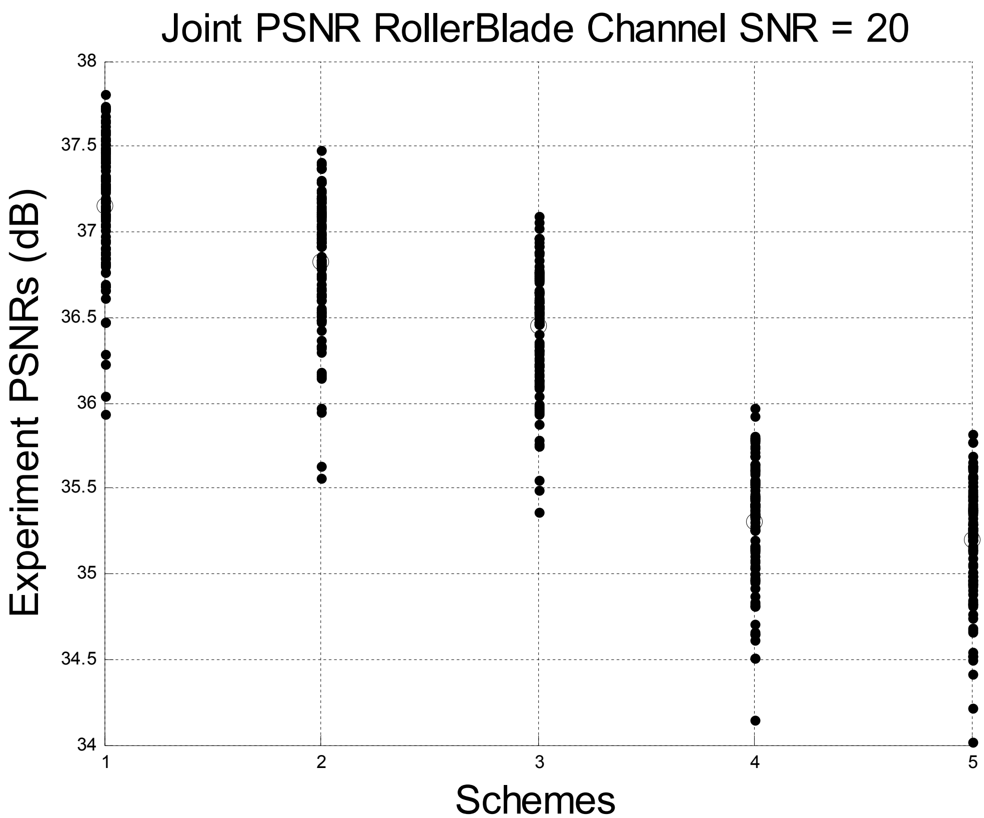

Figure 5: Joint PSNR distribution of 100 simulated experiments at channel SNR 20 dB for five different transmission cases (Roller blade video)

Table 9: R**eal reception** against **simulat**ions **(Roller blade video)**

Test Cases		PSNR (dB)			SSIM (0-1)		
		Left	Right	Joint	Left	Right	Joint
Real Reception	27_25_085	37.650	39.284	38.360	0.977	0.983	0.980
	27_26_085	37.749	38.418	37.968	0.976	0.976	0.976
	28_26_085	32.072	32.579	32.282	0.973	0.975	0.974
	28_30_085	32.133	31.984	32.057	0.973	0.971	0.972
	29_29_08	36.417	36.612	36.506	0.973	0.973	0.973
Simulation	27_25_085	36.691	37.996	37.158	0.965	0.966	0.966
	27_25_085	36.691	37.206	36.824	0.965	0.963	0.964
	28_26_085	36.023	37.187	36.445	0.961	0.964	0.962
	28_30_085	36.023	34.817	35.304	0.961	0.952	0.956
	29_30_08	35.265	35.282	35.193	0.957	0.955	0.956

References

[1] ETSI TR 102 377 v1.4.1, DVB BlueBook A092 Rev.3, Digital Video Broadcasting (DVB); DVB-H Implementation Guidelines.

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Mobile 3DTV Content Delivery Optimization over DVB-H System

MOBILE3DTV - Mobile 3DTV Content Delivery Optimization over DVB-H System - is a three-year project which started in January 2008. The project is partly funded by the European Union 7th RTD Framework Programme in the context of the Information & Communication Technology (ICT) Cooperation Theme.

The main objective of MOBILE3DTV is to demonstrate the viability of the new technology of mobile 3DTV. The project develops a technology demonstration system for the creation and coding of 3D video content, its delivery over DVB-H and display on a mobile device, equipped with an auto-stereoscopic display.

The MOBILE3DTV consortium is formed by three universities, a public research institute and two SMEs from Finland, Germany, Turkey, and Bulgaria. Partners span diverse yet complementary expertise in the areas of 3D content creation and coding, error resilient transmission, user studies, visual quality enhancement and project management.

For further information about the project, please visit **www.mobile3dtv.eu**.

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