

# Laboratory of Digital Video and Television Technology

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**Abstract.** *This short paper provides information on the technical instrumentation and application possibilities of the newly installed laboratory of digital video and television technology at the Department of Radio Electronics FEEC BTU in Brno. This laboratory can be used for laboratory education and research.*

## Keywords

Laboratory, measurement, digital technique, video technology, television technology, education, research.

## 1. Introduction

The new laboratory of digital video and television technology was established at a cost of over CZK 3 million at the Department of Radio Electronics FEEC BTU Brno in the year 2003. The funding was obtained from the FRVŠ grant agency project, which won the Czech Ministry of Education award for the excellent solution of this project.

The laboratory is equipped with first-rate and expensive measuring technique, which complements the current equipment of the laboratory for digital measurement and experimentation in this highly topical area of communication technology. Students of BSc and MSc Study programmes “Electrical Engineering, Electronics, Communications and Control Technique” acquaint themselves in a practical way with the function and testing of modern digital television systems and with the measurement of digital video-signals in the basic and in the high-frequency bands. The laboratory also serves the research activities of PhD students and workers of the Department of Radio Electronics. It can be exploited within the frame of co-operation with other universities and research institutions that will show interest in this collaboration. This paper therefore presents the basic information about the structure, potentials and technical equipment of this laboratory.

## 2. Instrumentation and Technical Equipment of the Laboratory

The laboratory has currently at its disposal (in addition to the standard measuring devices) special measuring

devices for generation, recording, analysis and measurement of parameters of television and radio digital signals in the basic and in the high-frequency bands:

- **DVRG (Rohde-Schwarz) - generator and recorder** of MPEG-2 digital compressed signals (compatible with the DVB and ATSC standards) with 80 GB hard disk, ASI/SPI interfaces, and **DVG - B1** software for the co-operation and control of all functions of DVRG by PC computers,
- **DVMB (Rohde-Schwarz) - measuring decoder and analyzer** of transport streams of digital signals for the DVB and ATSC standards, and **DVMD-B1** software for the co-operation and control all functions of DVMB by PC computers,
- **SFL-T (Rohde-Schwarz) - measuring test transmitter** for digital terrestrial broadcasting in the DVB-T and ATSC standards with ASI/SPI input interfaces (Fig. 1),



Fig. 1. Measuring test transmitter SFL-T (Rohde-Schwarz).

- **MSK 33 (Kathrein) measuring receiver and analyzer** for the reception and measurement of parameters of analogue and digital signals of all standards (DVB-S, DVB-C, DVB-T), inclusive of the MPEG-2 decoder and color monitor (Fig. 2),



Fig. 2. Measuring receiver and analyzer MSK 33 (Kathrein).

- **PROLINK – 4C (Promax) - measuring receiver and analyzer** for the reception and measurement of parameters of analogue and digital signals of all standards (DVB-S, DVB-C, DVB-T, DAB), inclusive of the MPEG-2 decoder and color monitor,
- **PROMAX 10 (Promax) - measuring receiver and analyzer** for testing and measuring the parameters of analogue and digital signals of the DVB-C, DVB-T, DAB standards,
- **PROLINK – 3+ (Promax) - measuring receiver** for reception and measurement of parameters of analogue and digital signals of the DVB-S and DVB-C standards with black & white monitor,
- **DMR-H2SE (Panasonic) - DVD/CD/CD desk recorder** with 80 GB hard disk and analogue and digital inputs,
- **DVP-S7224D (Sony) - DVD/CD/VCD desk recorder**,
- **DVD VDR-M3EG digital video camcorder (Sony)**,
- **DV NV-DS15 - digital video camcorder (Panasonic)**,
- **TH 42PW5 - plasma display (Panasonic)**,
- **Power Shot S20 (Cannon), C-4000 Zoom (Olympus)- digital photo cameras**.

Obviously, this pack of measuring devices is not complete. It shall be complemented depending on the financial possibilities of our Department and the evolution of technical state in this area. Nevertheless, it has been possible to build several workplaces that enable a number of very valuable experiments and measurements in the area of digital television and video technique.

### 3. Basic Measuring Workplaces of the Laboratory

Four basic, but in the light of measuring technique very flexible measuring workplaces for the realization of sophisticated laboratory exercises, demonstrations and scientific experiments in a wide area of current digital television and video technology were realized by means of this set of special measuring devices. These workplaces are equipped in particular for:

- generation, reception, recording, and measurement of digital signal parameters of the DVB-T standard (Fig. 3),
- generation, recording, measurement, and monitoring of compressed digital data (MPEG 1,2,4) in the basic frequency band,

- generation, reception, recording, and measurement of digital signal parameters of the DVB-S standard (Fig. 4),
- generation, reception, recording, and measurement of digital signal parameters of the DVB-C standard,



Fig. 3. The workplace for measurement of digital signals of the DVB-T standard.



Fig. 4. The workplace for receiving of and measurement of digital signals of the DVB-S standard.

### 4. Examples of Measurements and Experiments

With regard to the complication of operating these measuring devices it was necessary to prepare basic (short) service instructions so that all students should be able to carry out the measurement within the time allotted for the exercise. Furthermore, in the introductory exercise students are made acquainted with the operation of these measuring devices. The laboratory equipment makes it possible to realize in particular these measurements and experiments:

- investigation of the influence of real transmission channel properties on the parameters of transmitted compressed and uncompressed digital video-signals

in the basic frequency band, and on the quality degradation of corresponding pictures - the measurement of: signal level, signal-to-noise ratio S/N, the BER (Bit Error Ratio) factor, „eye“ diagram, etc.,

- measurement of parameters, spectral analysis, recording and monitoring of digital signals of satellite broadcasting (the **DVB-S** standard with QPSK modulation) – measurement of signal level, signal-to-noise ratio C/N, the BER factor before and after the Viterbi correction, analysis of transport stream structure, inclusive of monitoring the corresponding pictures,
- measurement of parameters, spectral analysis and recording of cable distributed signals (the **DVB-C** standard with n-QAM modulation) - measurement of signal level, signal-to-noise ratio C/N, the BER and MER (Modulation Error Ratio) factors, monitoring of constellation diagrams, spectral analysis, analysis of transport stream structure, inclusive of monitoring the corresponding pictures,
- generation, broadcasting, reception and measurement of parameters of digital terrestrial broadcasting (the **DVB-T** standard with COFDM modulation) in different reception conditions - measurement of signal level, signal-to-noise ratio C/N, the BER and SER (Symbol Error Ratio) factors, the CSI (Channel State Information) state information factor, spectral analysis; investigation of the influence of: frequency band, motion of a receiver, signal reflections (multiple reception), noise and disturbance in a transmission channel, influence of the guard interval, code rate, number of subcarriers and their modulation (QPSK, n-QAM) on the parameters of received signals and quality distortions of corresponding pictures; analysis of transport stream structure, inclusive of monitoring the corresponding pictures,
- measurement of the influence of DV digital magnetic recording and DVD digital optical recording on the parameters of recorded digital video-signals, objective and subjective evaluation of picture quality,
- testing of the structure of MPEG-2 program packets and investigation of the influence of compression algorithms on the objective measured parameters of digital video-signals and on the quality of corresponding static and dynamic variable visual sequences.

## 5. Conclusion

This paper provides basic information on the newly installed laboratory of digital video and television technology in the Department of Radio Electronics FEEC BTU in Brno. The laboratory is designed for practical education of students of BSc and MSc study programmes „Electrical Engineering, Electronics, Communication and Control Technique“, and for the research activities of department workers. At the same time the paper presents an informal offer of collaboration with teachers and research workers of other universities, research institutions and technical practice in this very topical area of communication technology. The laboratory will be exploited for student education since the academic year 2004-2005.

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## About Author...

**Václav ŘÍČNÝ** (member of IEEE) was born in 1937. He is professor at the Faculty of Electrical Engineering and Communication of the Brno Technical University. His research interest includes, in particular, video and television technology, analogue and digital processing, and digital measurement.