

# Agenda for the Final Meeting IND16 'Ultrafast'



The final meeting will take place on 18/19 June 2014 in Prague at the Czech Technical University, Faculty of Electrical Engineering, see link below. The envisaged time slots might vary slightly, but the overall structure will be maintained.

## Wednesday, 2014-06-18

- 12.30 – 12.45 Welcome (Martin Hudlicka)
- 12.45 – 14.15 Discussion of administrative/management issues: reporting (final financial and technical report), webpage, ... (Mark Bieler, **open to JRP partners only**)
- 14.15 – 15.00 Discussion of impact issues: newsletters, conferences, workshops, national meetings, collaborators, ... (David Humphreys, Mark Bieler, **open to JRP partners only**)
- 15.00 – 16.00 Discussion of confidential issues related to scientific/technical tasks in all WPs (all, **open to JRP partners only**)
- 16.00 – 17.00 WP1 Waveform metrology for ultrafast electronics (Mark Bieler, see page 2 for details, **open to JRP partners and collaborators**)
- 17.00 – 18.00 WP2 Uncertainty propagation between time- and frequency domains (David Humphreys, see page 2 for details, **open to JRP partners and collaborators**)
- 19.00 Dinner (restaurant TBD)

## Thursday, 2014-06-19

- 9.00 – 10.30 WP3 Propagation measurements, channel and antenna characterisation (Mohammed Salhi, Thomas Kleine-Ostmann, see page 3 for details, **open to JRP partners and collaborators**)
- 10.30 – 12.00 WP4 Measurement of digital signal properties (Martin Hudlicka, see page 3 for details, **open to JRP partners and collaborators**)
- 12.00 – 13.00 Lunch
- 14.00 – 16:00 Lab Tour at CMI (Martin Hudlicka, only if sufficient interest)

Coffee/tea will be available. Breaks will be done whenever required.

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Summary of technical talks (open to JRP partners and collaborators)

## **WP1 Waveform metrology for ultrafast electronics (lead: Mark Bieler, ~1 h)**

### **The femtosecond laser as a microwave instrument**

*Mark Bieler, PTB, ~40 min*

We describe the development of a one-port ultrabroadband laser-based vector network analyzer. Measurements are carried out in the time-domain by using a femtosecond laser for the generation and detection of ultrashort voltage pulses on a coplanar waveguide. We obtain a frequency spacing of 500 MHz and a measurement bandwidth of more than 500 GHz. As an application example we use the laser-based vector network analyzer for the realization of an ultrabroadband voltage pulse standard, the calibration of sampling oscilloscopes as well as el. pulse generators, and discuss amplitude and phase measurements of free-space GHz/THz emitters.

### **The electro-optic sampling system at NPL**

*David Humphreys, NPL, ~20 min*

We will present an overview of the NPL electro-optic sampling system and briefly discuss the comparison of electro-optic measurements on a CPW between NPL and PTB.

## **WP2 Uncertainty propagation between time- and frequency domains (lead: David Humphreys, ~1 h)**

### **Development of the Principal Component Compression Method for Covariance Matrices algorithm for Uncertainty Propagation**

*David Humphreys, NPL, ~20 min*

We will present the development of the algorithms to compress the covariance uncertainty matrix. The objective of reducing the data storage requirements to scale proportional to the trace length  $n$  rather than  $n^2$  is achieved, making the approach practical for representing results and uncertainties in either the time or frequency domain. Mathematical manipulation of the compressed matrix can be achieved without the need to reconstruct the full covariance matrix. We have demonstrated compression of datasets containing up to 10 000 complex frequency components.

### **Independent Monte-Carlo verification of the principal component compact covariance compression method**

*Manuel Rodrigues, INTA, ~20 min*

A Monte-Carlo technique has been employed for the verification of the covariance compression method. This talk outlines the objectives, method of realisation and results of the Monte-Carlo calculations.

### **Python, Matlab and C++ Software realisations of the principal component compact covariance compression method**

*Dongsheng Zhao, VSL, ~20 min*

We have realised aspects of the Principal Component Compression Method for Covariance Matrices in Matlab, Python and C++. We will outline the availability and performance of each of these realisations.

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## **WP3 Propagation measurements, channel and antenna characterisation (lead: Thomas Kleine-Ostmann, ~1.5 h)**

### **Overview of work performed within this workpackage**

*Thomas Kleine-Ostmann, PTB, ~20 min*

In this workpackage measurement techniques for millimeter and sub-millimeter wave radiation were investigated and improved. This includes for example, wideband propagation measurements in different indoor communication environments. Moreover, planar and horn antennas were characterized with respect to gain and directivity. We will first give an overview of the work performed within this workpackage and discuss details in separate talks thereafter.

### **Antenna Design & Characterization in mm wave region**

*Mohammed Salhi, PTB, ~15 min*

### **Broadband propagation measurements up to 325 GHz**

*Mohammed Salhi, PTB, ~15 min*

### **mm-wave antenna and propagation measurements**

*Djamel Allal, LNE, ~20 min*

### **Propagation of millimetre waves in atmospheric hydrometeors**

*Martin Grabner, CMI, ~20 min*

## **WP4 Measurement of digital signal properties (lead: Martin Hudlicka, ~1.5 h)**

### **Characterization of vector signal analyzers**

*Martin Hudlicka, CMI, ~20 min*

We summarize methods for traceable characterization of vector response of modern vector signal analyzers. The methods use oscilloscopes with direct traceability to SI units.

### **Calibration algorithm and test results for Vector Signal Generators**

*David Humphreys, NPL, ~20 min*

Vector Signal Generators are essential to realize digital RF communications. We will outline a calibration method that corrects for the imbalance and crosstalk present in the in-phase (I) and quadrature (Q) channels of these instruments and show results for a test system.

### **Uncertainty propagation of digital signals' VSA software**

*Kari Ojasalo, MIKES, ~20 min*

Software application for analysis of a digitally modulated signal will be presented. The propagation of uncertainties from the measured waveforms through the demodulation process will be discussed.

### **Traceability for commercial VSA software**

*Faisal Mubarak, VSL, ~20 min*

Methods used to make commercial digital demodulation software traceable will be presented.

### **User guides for VSA, VSG calibration and commercial software characterization**

*Martin Hudlicka, CMI, ~10 min*

User guides for calibration of vector response of modern vector signal generators and analyzers. The final shape and content of the documents will arise from the discussion in order to make the documents suitable for calibration laboratories and end users.

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