Dipl.-Ing. Martin BENEDIKT  
Betreuer: Hofer

An adaptive Coupling Methodology for Fast Time-Domain distributed heterogeneous Co-Simulation  
In the automotive industry well-established different simulation tools targeting different needs are used to mirror the physical behavior of domain specific components. To estimate the overall system behavior coupling of these components is necessary. As systems become more complex, simulation time increases rapidly by using traditional coupling approaches. Reducing simulation time by still maintaining accuracy is a challenging task. Thus, a coupling methodology for co-simulation using adaptive macro step size control is proposed. Convergence considerations of the used algorithms and scheduling of domain specific components are also addressed. Finally, the proposed adaptive coupling methodology is examined by means of a cross-domain co-simulation example describing a hybrid electric vehicle. Considerable advantages in terms of simulation time reduction are presented and the trade-off between simulation time and accuracy is depicted.

Dipl.-Ing. Christoph BÖHM  
Betreuer: Pribyl

Physical Unclonable Functions: Overview and Applications  
In the chip card and RFID area, identification, authentication, and cryptographic applications gain more and more importance. So-called physical unclonable functions provide a way for cheap and secure realization. The presentation provides a description of applications and evaluation criteria. Pros and cons of different integrated circuit-based approaches are introduced.

Dipl.-Ing. Stefan ERB  
Betreuer: Pribyl

Jitter Analysis at High-Speed - How to Extrapolate a Probability Distribution  
With data rates reaching beyond the Gbps range, timing jitter has become a major limiting factor for todays high-speed communication systems. An algorithm is presented which accurately determines the impact of timing jitter on system performance. Based on collected jitter histograms, the method investigates Gaussian tail behavior of measured distributions using an efficient optimization procedure. The resulting timing budget can be used to identify the bit error rate (BER) of high-speed serial links and for the quantification of jitter in clock signals and phase locked loop (PLL) systems. The efficient estimation principle allows for implementation as embedded system, and can further be generalized for use with non-Gaussian distributions.

Dipl.-Ing. Markus FLOHBERGER  
Betreuer: Koudelka

Advanced Satellite Monitoring Using Blind Demodulation Techniques  
In order to alleviate the job of satellite operators, the need for automatic monitoring systems grows with the increasing complexity of communication networks. It is evident that automatic monitoring is most challenging due to the large number of unknown parameters; however, the growing amount of available computational power combined with the benefits of digital signal processing on SDR platforms allows implementations that were not even thinkable a decade ago. The core part of such monitoring systems is a blind demodulation framework. The developed framework will be presented and its capabilities will be verified in several examples.

Dipl.-Ing. Martin GOSSAR  
Betreuer: Pribyl

Enhanced data rates for 13.56 MHz - RFID Systems  
The following presentation deals with the general modelling of 13.56 MHz RFID Systems. The focus is to enhance the data rates from the actual standardized 848 kbit/s up to 6.78 Mbit/s. To be able to enhance the data rate in a stable way, the system has to be understood, and the effects of the systems have to be pointed out. Therefore the effects are separated in static, which are always and system related, and dynamic effects, which are caused by bringing a card into the field of the reader. Furthermore the best modulation scheme for the communication PICC to PCD should be pointed out.
**iTire - TPMS and RFID attached on the inner liner of a tire**

In this presentation a battery-less tire pressure monitoring system will be introduced. The chip is mounted on the inner liner of a tire and powered by energy harvesting. An on-chip sensor measures the temperature. For pressure monitoring an external sensor device is necessary. The sensor data is transmitted by an active transmitter. A bulk acoustic wave resonator is used as external frequency reference. The chip is also capable of RFID in a frequency range from 1MHz to 2.45GHz. RFID is either used for identification purposes or sensor data transmission. The focus of the presentation will be on the power management.

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**Digitally controlled linear voltage regulator**

Linear voltage regulators are important devices in integrated circuits. They are necessary to supply different parts in a chip with their optimal voltage and decouple them from noise on the power supply. Traditionally linear voltage regulators are implemented with an analog control loop. In this work, a digitally controlled linear voltage regulator is presented.

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**Using Outliers in Structure and Motion Analysis to Reconstruct Foreground Motion**

We present a novel method to model independent foreground motion by using solely traditional structure and motion (S+M) algorithms. This is enabled by outlier analysis, a kind of information normally discarded by conventional S+M approaches. The core of this representation is a stable object center per object that is established online. Experimental results demonstrate the viability of this method. Major results include the computation of a stable representation of moving foreground objects and motion trajectories that can be used for motion analysis of objects.

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**A Novel Run-Time Model Switching Methodology for the Holistic Co-Simulation of Complex Heterogeneous Systems: Use Case FlexRay Networks**

Automotive network technologies such as FlexRay present a cost-optimized structure in order to tailor the system to the required functionalities and to the environment. Simulation is required to support this approach. The main challenge while simulating complex architectures such as FlexRay is to efficiently integrate the heterogeneous models in order to obtain accurate results for a relevant operation time of the system. Additionally, efficient integration of mechanics and microelectronics components is nowadays a must within the automotive industry in order to minimize integration risks and support optimization of the entire system. Within this work, a co-simulation environment dealing with these problems is presented.

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**Development of passive miniaturized components using LTCC technology for RF and microwave applications**

A variety of existing communication standards (mostly wireless) provides wide spectrum of service. Modern communication equipment supporting multi-functional operation tries to cover as much functions as possible. A common multi-frequency transceiver supporting FDMA (frequency division multiple access) incorporates front-end part which comprises a number of passive elements such as a filter, a balun, a multiplexer and different matching circuits. The main function of the HF (high frequency) front-end part is to separate and combine frequency channels, where the most challenging process assumes contiguous channels located closely to each other. The presentation is confined with this problem and focused on development of new component solutions resulting in size miniaturization and performance improvement.
Increasing Runtime Performance and Verification Effort of Anti-Tearing Mechanisms of Embedded Systems – Early Results of the HiPerSec Project

Smart Cards, and Java Cards in special, need to provide a set of security features. In most cases, these features come with a performance penalty for the application running on the smart card. HiPerSec investigates the consideration of security requirements in early design phases of a HW/SW codesign flow. In this presentation I will present early results of the HiPerSec project. In detail, it covers the anti-tearing mechanism, which is one of the most important security mechanisms for embedded systems without a reliable power supply. The anti-tearing mechanism ensures persistent data consistency, even if the power supply breaks down during a write operation into persistent memory. The presentation will cover details about anti-tearing mechanisms and new approaches to increase their execution performance and their verification effort.

Icing Detector and Condition Monitoring for Overhead Power Transmission Lines

Online condition monitoring of overhead power lines provides a 24/7 observation of power lines. With energy harvesting from the electric field that surrounds the conductor, a monitoring system can operate as soon as the power line is turned on. Quantities of interest comprise the distance between conductor and ground (or other objects), temperature, degree of icing, vibrations and others. Measurement data can be transmitted using relay stations or GSM networks. A prototype was fabricated and evaluated. The system concept, energy harvesting and measurement circuitry are presented and the results of temperature and icing measurements in both a laboratory environment and a field test are reported.

Inverse Problems

The term "Inverse Problem" in general means a class of problems where someone tries to determine an unknown quantity \( p \) from known data \( d \) given a model \( d=f(p) \). The stable inversion of \( f \) can be impossible when the inverse problem has the attribute of being "ill-posed". Only prior knowledge can help here to find a solution. Typical examples for such ill-posed inverse problems are soft field tomography but also hard field tomography with limited observation angle. In tomography, usually the material distribution within some region of interest is determined by measurements from outside of the region.

This presentation first gives an overview about some different inverse problems that arise in electrical engineering. In the later the idea of using tomographic methods for safety applications is presented. The further talk will also treat issues that are currently under investigation i.e. the handling of measurement uncertainties and model imperfections due to discretization errors and poor calibration, the lack of 3D effects or physical effects like wave propagation that can be neglected under certain circumstances. Approaches and work in progress to cover these effects will be given.

An interleaved, model-supported system identification scheme for the particle accelerator CLIC

The particle accelerator CLIC is a future linear collider, which is developed at CERN. The quality of the particle-beams produced by CLIC is very sensitive to ground motion. The efficiency of the feedback used to counteract ground motion, relies crucially on the quality of the system knowledge. Therefore, in the current talk a a system identification scheme to follow changes of accelerator parameters is presented. The algorithm is based on the well-known RLS (recursive least squares) algorithm with exponential forgetting, but adds modifications to improve the learning speed and to address excitation onstrains given by the system. Parallel-running, interleaved RLS algorithms identify parts of the overall system. The different results are combined by using a priori knowledge. The modified algorithm can follow system changes with a factor 30 improved learning speed, compared to the conventional RLS algorithm. It works robustly, despite of sensor noise and disturbances acting on the excitation signals.
Dipl.-Ing. Hannes REINISCH  
Betreuer: Pribyl

**Power Sources and RFID for an Advanced Tire Pressure Monitoring System**

Tire Pressure Monitoring Systems (TPMS) have become an important safety feature in modern vehicles. In the project Itire the TPMS is enhanced by capturing additional sensor data and implementing RFID technology. Using RFID the logistic of the tire manufacturers as well as the OEM production process can be optimized and tracked. During the monitoring operation the sensor data can also be transmitted by using the implemented RFID functionality. Due to the fact that the system is mounted in the inner liner of the tire, weight reduction plays a decisive role and so the chip is powered by alternative concepts like electro-magnetic energy harvesting. This presentation starts with a short overview of the power sources of the Advanced TPMS and focuses on the implemented RFID tag in the frequency ranges of HF at 13.56 MHz, UHF at 865 to 965 MHz and Microwave at 2.45GHz.

Dipl.-Ing. Martin SOMMER  
Betreuer: Brasseur

**Electrochemical Modeling of a single Li-Ion cell**

Due to the increasing amount of secondary lithium batteries in consumer electronics combined with the upcoming interest in electromobility fast and accurate battery models are getting more and more important. In the first talk of the doctoral school two main modelling approaches for electrochemical energy storage devices are discussed with a special focus on the electrochemical method of battery modelling. A numerical realization based on a set of equations representing the main reactions during charge and discharge cycles is demonstrated. Furthermore, first simulation results are presented and compared to measurement data. The actual research is shown on examples of the ongoing code improvements with respect to calculation speed and accuracy.

Dipl.-Ing. Michael SOUDAN  
Betreuer: Kubin

**Time-Interleaved Analog-to-Digital Converters**

Analog-to-digital converters serve as an interface between the analog and digital domain in todays communication systems with a demand of ever increasing resolution accuracy and sampling speed. By time-interleaving several converters, it is possible to enhance the sampling speed of the overall system according to the number of utilized converters. While time-interleaving allows the designer to increase the sampling rate of this system quite easily, the spectral purity of its output is compromised by dissimilar characteristics of the individual samplers. This results in undesired signal components which reduce the effective resolution of the system and thus prevent its usage in challenging applications. In the following, the cause for these errors is explained and method for mitigating their impact are presented. Employing these methods for post-processing the converter outputs, the accuracy of the overall system can be enhanced.