1. Determining a reliable algorithm for the factor analysis of Auger Electron Spectroscopy (AES) data.

RESEARCH GROUP ELECTROCHEMICAL AND SURFACE ENGINEERING
DEPARTMENT MATERIALS AND CHEMISTRY
VRIJE UNIVERSITEIT BRUSSEL
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Auger Electron Spectroscopy (AES) is a very powerful surface analysis technique. It allows the study of material's surfaces (upper 5 to 75 Å) with a lateral resolution going down to 10 nm. The atoms present are identified straight forward through the energy of the detected Auger electrons created when bombarding the surface under study with a primary electron beam. For some applications it is not sufficient to know which elements are present at the surface of a sample, but also in which chemical environment these atoms are present. Chemical compounds can be identified from recorded Auger data, but to do so some mathematical tools, like factor analysis (FA), are needed. During a FA, first the number of principal components needed to rebuild the experimental data set is determined. In a second step, these principal components can be identified using some standards of the chemical compounds suspected to be present in the sample under study.

In SURF, some experience has been acquired during the past years on how to apply factor analysis tools available in data treatment software. However, these 'black box' approaches show their limitations upon the reliability of the obtained results. Especially concerning the determination of the number of relevant principal components, the tools used until now show their limitations. Therefore, a new approach for determining the number of relevant principle components will be developed that takes into account the measurement uncertainty. The proposed method requires at least 2 independent measurements and some advanced data processing techniques developed at the department ELEC. The data processing will be performed in Matlab®.

As a continuation of previous research, we will use nitrided iron samples as standard samples to establish the reliable algorithm for the factor analysis. First, high resolution Auger data need to be acquired. In parallel, the algorithm must be set up. In a second phase, the available data will be analysed through factor analysis. This should result in the known chemical composition of the standard samples. In a last step, some unknown samples could be identified with the FA algorithm. As such this thesis will be an essential step towards the reliable chemical analysis of materials with AES.

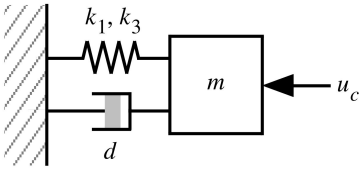
In collaboration with the ELEC department
For more information, please contact:
Isabelle Vandendael (ivddael@vub.ac.be)
Rik Pintelon (rik.pintelon@vub.ac.be)

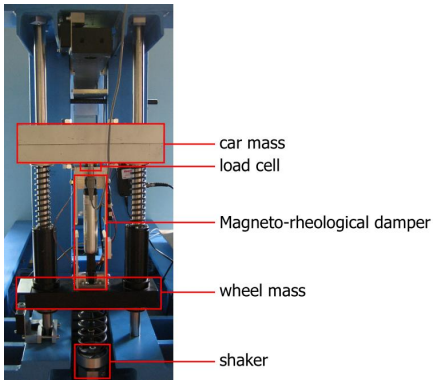
2. Niet-lineair modelleren: alles kan beter

Promotor: Prof. Johan Schoukens
Copromotor: Laurent Vanbeylen

Een systeem wiskundig beschrijven zonder de onderliggende (fysische) structuur te kennen? Het kan!

In deze thesis, bedoeld voor al wie interesse heeft in de systeemidentificatie, kom je in contact met performante modelleringstechnieken voor dynamische niet-lineaire systemen, welke in de praktijk bijna overal voorkomen.

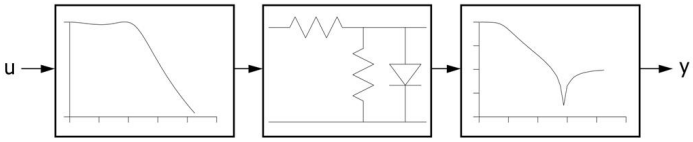




Je krijgt inzicht in de relatief krachtige, bestaande state-of-the-art methodes die op ELEC zijn ontwikkeld om een goed (niet-lineair state-space) model op te stellen op basis van meetdata.

Alles is echter nog niet perfect, en dus moeten nog een aantal moeilijkheden van de baan worden gehaald.

1. Er kunnen bijvoorbeeld lokale minima ontstaan tijdens de numerieke optimalisatie, wat kan leiden tot suboptimale resultaten.
2. Bovendien kunnen de huidige methodes op dit moment een model opleveren dat instabiel reageert, als je het exciteert met een verschillende ingang.



Het oplossen van deze twee problemen (bijv. a.d.h.v. verbeterde optimalisatiestrategieën en een gewijzigde, gegarandeerd stabiele modelstructuren) kunnen een grote meerwaarde zijn voor het bestaande raamwerk.

Er liggen al een paar ideeën klaar om uit te proberen, wat je eerst zal doen op eenvoudige voorbeeldjes.

Daarnaast is er ook gelegenheid om de methodes toe te passen op echte metingen (bv. elektronisch, mechanisch, ...).

Goede resultaten kunnen leiden tot een publicatie op een internationaal congres.

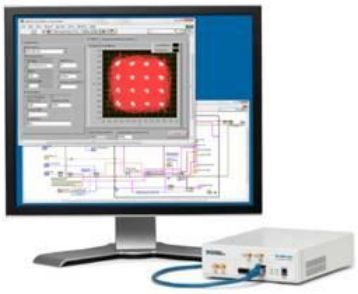
Aarzel vooral niet om contact op te nemen (laurent.vanbeylen@vub.ac.be) voor extra inlichtingen.

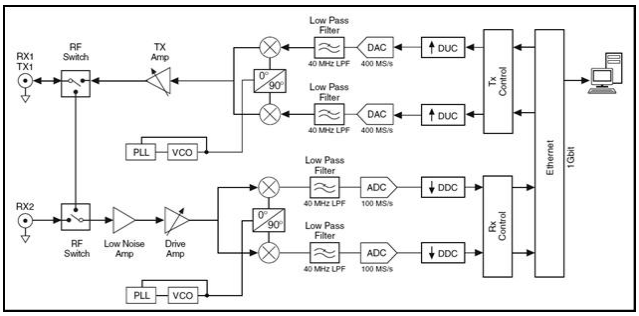
3. Make your own wireless telecom link!

Promoters: Gerd Vandersteen & Leo Van Biesen

The aim of this thesis is to study different digital communication protocols used in wired and wireless communications and the use of modeling, calibration and compensation to increase the performance of the system.

The system under study is the NI USRP, a user programmable software defined radio (SDR) of National Instruments (NI). Its hardware contains IQ modulators and demodulators to convert the signals from the high speed ADCs and DACs to the GHz range. Furthermore, the digital signals can be processed directly using an FPGA-based DSP system that can be programmed through the LabView runtime environment of NI.





The first step will be to study different wireless protocols and to implement them in the NI USRP environment. Starting from simple PSK and QAM modulation, the target is to finally develop a complete OFDM-based system similar to a WiFi protocol.

The compensation of non-idealities, such as the channel characteristics, non-linear distortions in the electronics, frequency and timing deviations ..., is crucial for the high performance of modern communication. These modeling and calibration techniques will be studied and implemented using the NI USRP system.

What will you have learned?

- Expertise in a lot of different telecommunication protocols
- Hardware and software experience for measurement and compensation on non-idealities, including linear and nonlinear distortions, time jitter and phase noise, …
- Possibility to design and make your own hardware setups to demonstrate particular communication problems (e.g multipath, interference, fading, …)

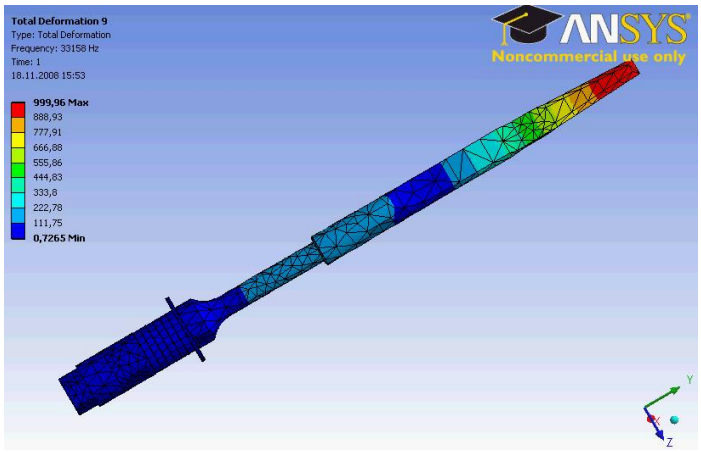
4. Design of a driving system for Piezoelectric Ultrasonic Knife

Promoter: Gerd Vandersteen
Daily advisors: David Oliva Uribe / Gerd Vandersteen

Ultrasonic cutting uses small ultrasonic vibrations to reduce the mechanical friction between knife blade and cutting material. Typical industrial applications for ultrasonic knifes can be found in food industry to make thin slices of bread or cakes without critical deformations.

Recently ultrasonic knifes have been utilized in medical field for several procedures. Ultrasonic cutting has demonstrated to be efficient for resection of tumors or coagulation of blood vessels. The advantages of the use of an ultrasonic knife (scalpel) in medical procedures are the reduction of tissue damage and operation times, less blood loss, and more rapid healing in comparison with other surgical instruments.

During this thesis you will design and construct the electronic driving system for a real prototype of one ultrasonic knife. The work includes laser vibrometer measurements to characterize the mechanical performance of the knife in order to achieve an optimal electronic driver. This design will include both analog hardware design to power the knife and measure its response, and a small microcontroller to control and monitor the performance of the knife. In addition you must perform real measurements with the knife to test its performance with different materials by characterization of friction and cutting force.



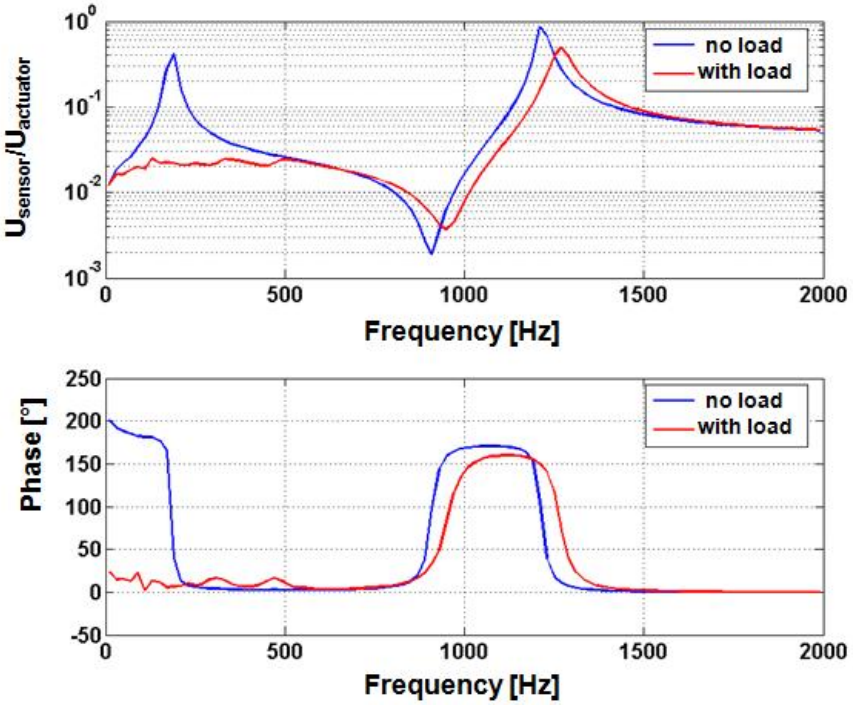
Contact: David Oliva Uribe, e-mail: dolivaur@vub.ac.be, Dept. ELEC, Vrije Universiteit Brussel

5. Vibration Mode Analysis of a Piezoelectric Bimorph used as Tactile Sensor for Medical Applications

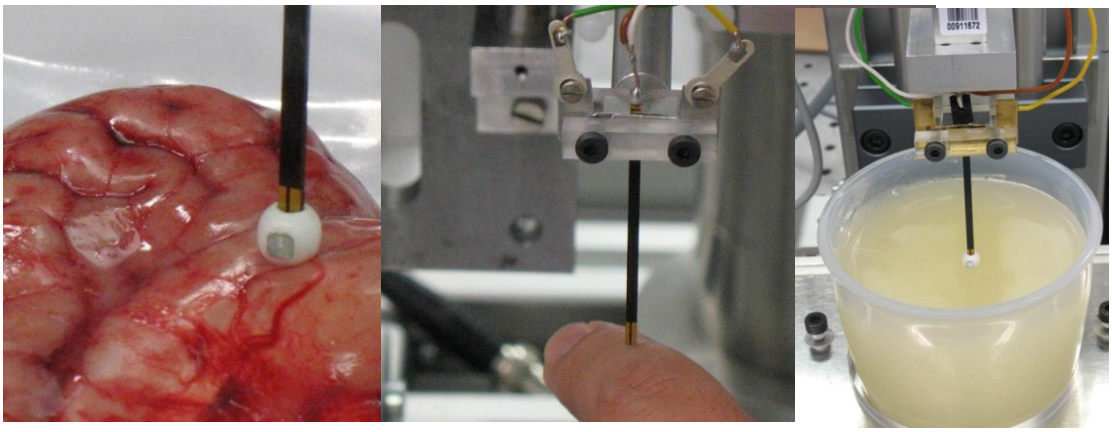
Promoter: Johan Schoukens
Daily advisors: David Oliva Uribe / Johan Schoukens

Tactile sensors are capable to provide information on the mechanical characteristics of the touched object in order to differentiate it from others.

Piezoelectric transducers have many advantages when using them to recognize surfaces, define contours or evaluate contact force/pressure. The VUB in cooperation with the University of Hannover is carrying on investigations for the development of tactile tools using piezoelectric transducers for assisting in tumor resection.



In this thesis you will work at ELEC with the measurement setup built for tissue differentiation. The aim is to investigate the links between the different vibration modes of the piezoelectric tactile sensor prototype and its corresponding Frequency Response Function (FRF). The work involves the use of different laser vibrometers techniques to measure the vibration modes when the sensor is in contact of load and the use of system identification techniques to evaluate the FRF. It is known that the complete system is nonlinear; therefore this will be taking into account for the generation of suitable models to describe this relationship.



Contact: David Oliva Uribe, e-mail: dolivaur@vub.ac.be, Dept. ELEC, Vrije Universiteit Brussel

6. Building your own blood pressure meter

Promotors
Name: Prof. Wendy Van Moer
e-mail: wendy.vanmoer@vub.ac.be

Name: Dr. Kurt Barbé
e-mail: kurt.barbe @vub.ac.be

One of the most popular medical instruments used at home is the automatic non-invasive blood pressure meter (NIBP). Most medicine cupboards contain one and a lot of people use it on a daily basis. A cuff is wrapped around the arm of the patient and inflated until the circulation stops. Most classical automatic blood pressure meters are based on the oscillometric principle, which records the oscillations in the cuff pressure during deflation of the cuff. Out of this oscillometric waveform a mean arterial pressure (MAP) as well as a systolic and diastolic pressure is deducted by means of a mathematical algorithm.

In this master thesis you will be able to design and develop your own blood pressure meter. State-of-the-art blood pressure meters are based on pressure measurements. A second type of blood pressure meters, however, uses sound waves. The purpose is to develop both types of blood pressure meters and to compare their performance.

By doing this master thesis you will become a master in practical design as well as in signal processing. So don't hesitate and contact us!

Figure 1 Commercial blood pressure meter

This master thesis will be performed within the Medical Measurements and Signal Analysis Team (M^2ESA) of the department ELEC. The research team M^2ESA combines powerful signal analysis tools and modeling techniques to medical applications such as calibrating blood pressure meters, non-invasive glucose sensors, functional Magnetic Resonance Imaging. A large expertise has been build up in signal reconstruction and analysis tools for diagnostics.

Website of the research group: http://wwwtw.vub.ac.be/elec/

7. Turning a good RF source into an ideal source

Promotors
Name: Dr. Kurt Barbé
e-mail: kurt.barbe @vub.ac.be

Name: Prof. Wendy Van Moer
e-mail: wendy.vanmoer@vub.ac.be

An RF vector signal generator never generates spectrally pure excitation signals: on top of the desired spectral contributions additional unwanted frequency lines can be detected in the generated spectra. These unwanted components are due to the nonlinear contributions of the signal generator. When one wants to characterize the nonlinear behavior of a device, the observed nonlinear contributions in the output signals of the device, should be exclusively generated by the device itself and not by the signal generator. Hence, pure excitation signals are mandatory.

Recently a method has been developed to digital pre-distort the signal generator by means of parametric frequency-dependent modeling of the inverse of the nonlinear artifacts, including artifacts from in-phase (I) and quadrature (Q) modulation, leakage from the local oscillator (LO), and power amplifier.

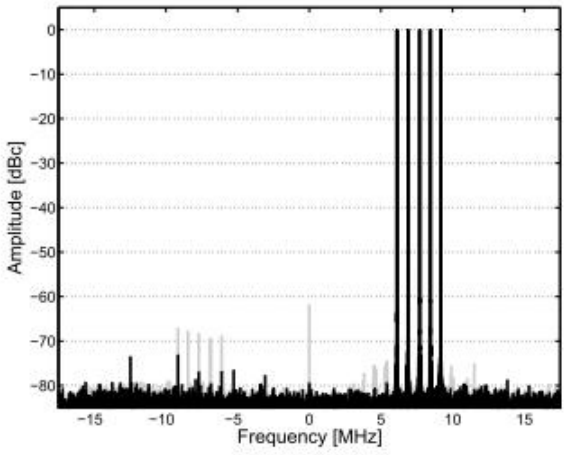


Figure 2 Unwanted spectral lines (gray) and corrected spectrum (black)

The goal of this master thesis is to extend this method by:

- Replacing the proposed finite impulse response (FIR) filters by infinite impulse response (IIR) filters to ensure maximal flexibility and a decrease in the number of estimated parameters.
- Taking into account the measurement noise. This is necessary since the input signal of the pre-distorter is now wrongly considered to be exact.

This master thesis allows you to get insight in arbitrary waveform generator, measurement techniques and signal processing as well as state-of-the-art digital pre-distortion techniques.

Website of the research group: http://wwwtw.vub.ac.be/elec/

8. Measuring the speed of the blood flow using a low-cost photonic sensor

Promotor 1
Name: Prof. Heidi Ottevaere (FirW-TONA)
e-mail: hottevaere@tona.vub.ac.be

Promotor 2
Name: Prof. Wendy Van Moer (FirW-ELEC)
e-mail: wendy.vanmoer@vub.ac.be

More and more people suffer, nowadays, from a too high cholesterol level in the blood. These cholesterol molecules attach to the arterial walls leading to obstructions in the arteries. This effect causes all kinds of problems, such as heart problems, thromboses,… To detect these thickenings in the artery walls, the Vascular Transit Time (VTT, the time for an arterial pressure wave to cover a predefined distance) is measured by means of ultra-sound Doppler. However, this technique is very expensive and needs an experienced laboratory technician.

To overcome these shortcomings a miniaturized and integrated photonic sensor consisting of an array of photodiodes that can be fabricated at low cost is needed to fully exploit the potential advantages of sensors for biomedical applications. The sensor will be applicable by layman users.

This master thesis is a joint effort of 2 research groups within the Faculty of Engineering Sciences at VUB, the Medical Measurements and Signal Analysis Team (M^2ESA/ELEC) and the Brussels Photonics Team (TONA). The research group M^2ESA combines powerful signal analysis tools and modeling techniques to medical applications such as calibrating blood pressure meters, non-invasive glucose sensors, functional Magnetic Resonance Imaging. A large expertise has been build up in signal reconstruction and analysis tools for diagnostics.

At TONA we have fabricated prototypes of miniaturized photonic sensors consisting of LEDs, photodiodes and integrated plastic optics and we have used them successfully in proof-of-concept demonstration set-ups. Up to now their measurement principle relies in most cases on laser-induced fluorescence and absorbance analysis. In this thesis you can go a step further and combine the expertise of both research groups to develop a blood flow speed sensor. The goal of your thesis is in a first step to build a proof-of-concept demonstrator by selecting the most appropriate source, detector and optics and secondly to apply the signal analysis tools to discriminate noise and the actual blood flow speed. This signal analysis allows optimizing the speed sensor to obtain the most accurate estimate of the blood flow speed. This sensor will form

a significant extension of a classical blood oxygen sensor and may also open a potential path to a new measurement technique for blood pressure meters.

This multidisciplinary master thesis, consisting of both signal analysis and experimental work, offers you challenging research opportunities within the framework of on-going research projects.

Illustration 1: Commercial oxygen blood sensor

Link to webpage or article related to the subject (optional):

- http://iopscience.iop.org/0967-3334/27/8/003/pdf/pm6_8_003.pdf

Website of the research group: www.b-phot.org, http://wwwtw.vub.ac.be/elec/

9. Modelling of transmission channels for G.fast next generation DSL

Promoters : Prof. Leo Van Biesen, Prof. Yves Rolain

Advisor at Belgacom: dr. ir. Carine Neus

Although FTTH (Fiber To The Home) is certainly the most powerful technology for fixed line communication, its economic viability and massive deployment is hindered by the high investment costs. As a consequence, several fixed line telecommunication operators are deploying hybrid fiber-copper last mile strategies instead where fiber is introduced in the access network to shorten the copper loop lengths. This reduces the copper attenuation and dramatically increases the usable frequency spectrum. Belgacom for instance has heavily invested in FTTC (Fiber To The Cabinet) since 2002 to offer HDTV 3-play services nationwide. Such hybrid fiber-copper investment strategies and DSL technology evolution are the chicken and egg of broadband over copper. For example a few years after ADSL was successfully deployed from the central office using frequencies up to 2,2MHz, VDSL2, using the frequency spectrum up to 30MHz, was specifically conceived for FTTC and FTTB (Fiber To The Building) network architectures. Since in many brownfield areas the step from FTTC to FTTH might still be a too difficult frog leap or too impractical for technology agnostic customers, new technologies on ultra-short copper loops are currently being explored in industry forums and standardization bodies. For instance the ITU-T G.fast project aims to standardize a transmission technology for copper loop lengths of maximum 200m using a much higher frequency spectrum, likely more than 100MHz and possibly up to 300MHz. This would allow bit rates of several hundreds of Mbps up to possibly 1Gbps on a single copper pair. The bit rate performance and stability on a real copper network will nevertheless be heavily dependent on the characteristics of the underlying transmission channels. Therefore the goal of this thesis is to assist in the modelling of copper telephone cables and cable topologies typically deployed by Belgacom at such high frequencies. The thesis will consist of the following activities:

- conduct a literature study regarding measurements up to 300MHz on copper
- build a measurement set-up to measure the S-parameters on copper wires up to 300MHz to derive the transmission channel characteristics (including crosstalk channels) and avoiding as much as possible parasitic measurement set-up effects
- measure copper cables and cable topologies typically deployed by Belgacom up to 300MHz
- investigate if extrapolation of currently available transmission channel models up to 30MHz towards 300MHz is possible

Interested? Just send an e-mail to cneus@vub.ac.be or lvbiesen@vub.ac.be.

10.Conceptual design of a crosstalk analyser for copper pairs

Promoter: Prof. Leo Van Biesen

Advisor at Belgacom: dr. ir. Carine Neus

VDSL (Very-high-bitrate Digital Subscriber Line) is the successor of ADSL, promising higher download and upload bit rates. Nevertheless, VDSL performances are drastically reduced in presence of high coupling crosstalk between copper pairs. If new technologies as vectoring can solve the problem, several cases cannot be completely solved notably if the performance target is high (up to 100 Mbit/s on a classic telephony copper pair).

Belgacom has already investigated in a tool concept to locate such high coupling issues. The tool consists of performing a TDR (time domain reflectometry) measurement at a single end of 2 pairs (sending signal on a pair & measuring on the other pairs) in order to “estimate” the evolution of the crosstalk coupling in function of the distance.

The first results show that it is possible to identify different types (signatures) of coupling: punctual or distributed (constant or random).

The following steps will consist to:

- Elaborate a mechanism to automatically adapt the measurement with the attenuation of the line (required to have a calibrated measure).
- Improve the tool concept for noisy environment.
- Refine the understanding of the signatures notably by studying/testing the use of FDR (frequency domain reflectometry) instead of TDR.

The thesis activities would typically consist of one or more of the following activities:

- Conduct a literature study regarding crosstalk and such type of measurement.
- Build a “software” simulator to assess the possible solutions.
- Build a measurement set-up in collaboration with Belgacom to implement the concepts and to validate the simulations.
- Realisation of a first prototype usable in the field.

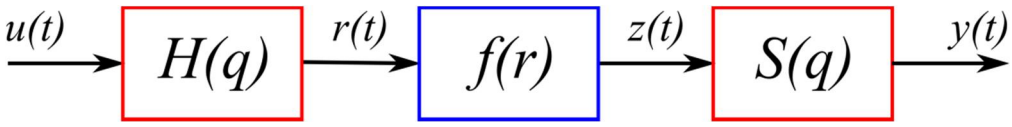
Interested? Just send an e-mail to cneus@vub.ac.be or lvbiesen@vub.ac.be.

11.Nonlinear modeling: Lego for advanced users

Daily advisor: Maarten Schoukens
Promoter: Yves Rolain

Nonlinear models are needed to decrease the product development cycle time, to obtain better performance of controllers, or to obtain a higher data-rate in telecommunication channels.

One approach of nonlinear modeling uses different building blocks: linear time invariant blocks and static nonlinear blocks. Just like playing with Lego blocks, one can build a model of very complex systems with very simple building blocks.



This thesis allows you to develop and improve state of the art block-oriented modeling techniques and apply them on real-life measurements. There are different open problems left, and waiting to be tackled by enthusiastic researchers. The typical challenges you can encounter during this thesis are simulation and measuring of nonlinear systems, parameter identification of nonlinear models, and (nonlinear) optimization of initial estimates.

Do not hesitate if you would like to discuss the possibilities, or if you would like to get more information.
Contact: maarten.schoukens@vub.ac.be

12.Taming nonlinear transmission lines

Promotor: Yves Rolain and Gerd Vandersteen

Are you convinced that transmission lines are boring pieces of metal separated by a silly dielectric slab? Do you believe that their contribution is to degrade signals only?

Be prepared to change your mind! In this subject, we will design a pulse shaping transmission line. Fed with a sine wave, it produces perfect square waves over a short line length.

This subject will introduce you to the amazing world of nonlinear transmission lines. Nonlinear lines lines consist of sections interconnections of distributed and lumped elements that we connect in tandem to obtain a distributed system. Designing such lines will bring you design experience and will introduce you to the nonlinear microwave world.

Potentially interested? Please come by to ask some more information

13.Real-Time signal processing in Labview

Promotor: Yves Rolain and Gerd Vandersteen

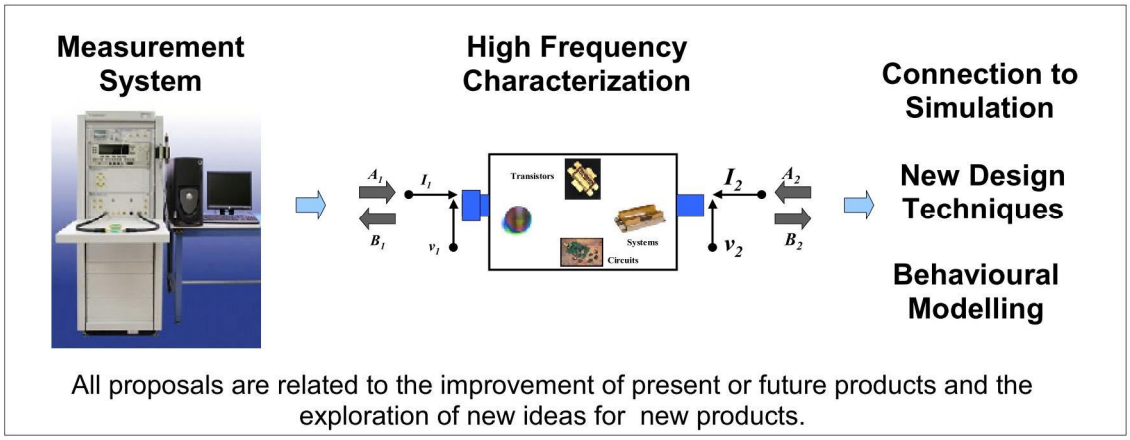
Real-time processing of measurement data is you piece of cake? What about the realization of a real-time 2 channel simultaneous signal acquisition and generation kernel running at 100 MHz based on FPGA?

With the right tools, it sounds worse than it actually is. That is why we propose to use the Labview FPGA environment as a development environment. The idea is to provide real-time operation in the spectral domain, with digital bandwidth control and, if possible, to try out new interpolation algorithms for the measurement of frequency response functions.

Potentially interested? Please come by to ask some more information

NMDG NV (www.nmdg.be) is a high-tech company, active in the high-frequency electronics market. NMDG plays worldwide a role in selling products and services that facilitate, accelerate and improve the design and testing of active high-frequency components, circuits and systems. These devices are used in telecommunications, satellite communications, high-speed digital electronics, etc.

For more information:
Marc Vanden Bossche
Phone: +32 3 890 46 12
Email: Marc.Vanden_Bossche@nmdg.be



All proposals are related to the improvement of present or future products and the exploration of new ideas for new products.

14. Instrumentation for Telecommunications and Aerospace

- A large-signal network analyzer based on a National Instruments PXIe-5186 HF Scope

  The goal of this project is to develop a large-signal network analyzer up to 5 GHz to visualize the RF behavior of RF components and systems. You will work with and improve an existing commercial measurement software that is being used in the characterization of electronic components. This software is mainly programmed in the .NET framework (C#). You also will need to put the hardware together to measure the incident and reflected waves at the ports of a device under test. You will need to think about the measurement principle of oscilloscopes and what the best way is to capture the highfrequency signals.

  You will work together with software and measurement experts and you will weapon yourself to be employed in the ICT or T&M industry. You will learn and practice object-oriented techniques and inter-process techniques, which are of interest in the ICT industry. When this project is successful, you will also contribute meaningfully to the evolution of an existing commercial product.
  Required ICT Skills: C-derived language programming (C, C++, Java, C#, ...

- A HF oscilloscope probe calibrator

  The goal of this project is to develop some hardware extension for a special pulse generator and a calibration process to compensate for the distortion of a high-frequency

oscilloscope probe. HF probes and even HF oscilloscope channels distort the signal from measurement point to the signal on the screen. You will develop some hardware and a program to determine the distortion and to compensate for it. Additionally you will demonstrate that it is possible that the impact of the probe can be taken into account in the verification process of the design. Indeed probes can change the performance of the circuit under test.

You will be able to work with high-frequency equipment and improve your understanding of HF measurements. Also you will have the opportunity to control instruments which benefits you in different industries where instrument control / monitoring is important. Also your software skills will be improved which creates an advantage for the ICT industry.

- Combining computer – aided engineering and test instrumentation results in better designs

  The goal of this project is to extend an existing commercial measurement software that is being used in the characterization of electronic components. This software is mainly programmed in the .NET framework (C#). With this extension it will be possible to simulate the power levels at different points in a measurement setup. Measurement setups are becoming so complex and need to deal possibly with high powers (> 100 Watt for base station applications) that it becomes necessary to estimate the power levels at different points to avoid destruction of instrument and components under test before any measurement. Secondly, it will be possible to perform simulations (e.g. Spice,...) in parallel with measurements. Amongst others, it allows direct comparison and validation of component models.

  You will write software, mainly C#, in an existing environment and work with the software experts. This software needs to communicate with computer-aided engineering (CAE) software. Engineers use CAE software extensively to simulate and predict the behavior of complex circuits.

  In this project you will weapon yourself to be employed in the ICT industry. You will improve your programming skills while working with software experts. You will learn and practice object-oriented techniques and inter-process techniques, which are of interest in the ICT industry. When this project is successful, you will also contribute meaningfully to the evolution of an existing commercial product.

  Required ICT Skills: C-derived language programming (C, C++, Java, C#, ...)

- •Instrument with dynamically defined device specifications

  The goal of this work is to provide a mathematical calculation engine in a commercial-available characterization and measurement environment that runs under .NET. The software was developed in C#. Working together with the software experts, the goal is to create a mathematical expression parser, which is able to calculate derived calculations on top of data that is already available. This way flexible calculations can be done on top of data that is already in the measurement environment.

  You will improve your object-oriented program skills, you will learn expression parsing techniques. These skills create advantages for the ICT and control industry. Additionally, you will contribute to the evolution of a commercial product.

  Required ICT Skills: C-derived language programming (C, C++, Java, C#, ...)

- Schematic Capture for Measurement Setups

  The goal of this project is to extend an existing commercial measurement software that is being used in the characterization of electronic components. This software is mainly programmed in the .NET framework (C#). With present software, complicated measurement systems can be composed. Unfortunately, there is presently no visualization of how the system looks like. The goal is to develop or adapt a schematic capture software that allows to pick, drag and drop instruments and to wire them together into a complete measurement setup.

You will work together with software experts and you will weapon yourself to be employed in the ICT or T&M industry. You will learn and practice object-oriented techniques and inter-process techniques, which are of interest in the ICT industry. When this project is successful, you will also contribute meaningfully to the evolution of an existing commercial product.

Required ICT Skills: C-derived language programming (C, C++, Java, C#, ...)

15.Measurement and Simulation Techniques for the Telecommunication market

- Amplifier design tool based on the emerging S-functions

  The goal of this thesis is to develop a program with graphical user interface that assists the amplifier designers. Amplifiers are crucial parts of any communication system. The requirements are very tough because on one hand they need to amplify signals without distortion and on the other hand they should not consume unnecessary power. Lately S-parameters were extended into S-functions and X-parameters™ to describe amongst others the behavior of amplifiers. It will be your work to extend some design concepts of S-parameters to this new type of model and to develop a tool that will speed up the amplifier design process.

  The outcome of the work is a prototype of a potential product that can assist many amplifier engineers.

  You will learn about design techniques of power amplifiers, which is import in the telecom market. Also you will have the opportunity to work on a your software skills in a professional environment, increasing your value for the ICE market.

- A test setup for high-speed component characterization

  The goal is to develop and realize a practical setup that allows to visualize the interaction between a high-speed input buffer and a high-speed output buffer. Due to the length of the connection reflections can go back and forth between the components while transistors switch between states. As far as we know, up to now the interaction has never been visualized in incident and reflected waves. The outcome of the project could be the basis for thinking about some new type of product. You will learn to build some RF analogue hardware, you will work with computers to control instruments and you will develop some software to perform some RF measurements. This will give you a good basis for any electronics industry and also for the software industry.

16.Accurate Measurements: the key to knowledge

- Error – analysis of Large-Signal Network Analyzer calibration techniques

  The goal is to study the systematic errors introduced on calibration coefficients of Large-Signal Network Analyzers and the impact on the waveform measurements. When calibrating a Large-Signal Network Analyzer, in many cases “well”-known calibration elements are used. Of course, they are not precisely known and as such errors are introduced in the calibration. On top of it, there is also measurement noise in the system. This measurement noise converts also in systematic errors.

  The outcome of the thesis should be an approach to provide specifications of the residual errors of calibration procedures, existing in commercial-available vector network analyzers. The thesis allows to learn a lot about how to characterize high-frequency components accurately, how RF instruments work and give you insight in calibration techniques. The work gives you a good basis to work in the industry, active in RF system, component design and manufacturing and prominent research institutes.

- High – speed digital circuit design requires advanced analogue characterization techniques

  The goal of this thesis is to identify how large-signal characterization techniques can help in the high-speed digital circuit design process. Measuring the analogue voltage and current

behavior, possibly under mismatch conditions taking into account the variability that occurs on printed circuit boards, helps to understand maybe problems in high-speed digital circuits. These new measurement techniques can also lead to improved behavioral models (e.g. IBIS models).

The outcome of the work can increase importantly the application area for large-signal characterization techniques. You will learn how to characterize high-speed digital circuits in the conventional way and will learn the more sophisticated characterization techniques of high – frequency analogue circuits. You will control instruments, process data and learn about behavioral models and the different design tools. The thesis will provide a good background for the RF industry and for the general electronics industry. It can also lead to some new interesting PhD subjects.