Radio & Mixed Signal Innovations

ROYAL INSTITUTE OF TECHNOLOGY

6th RaMSiS Summer School

Next Generation Mobile Communications: Chipset Design and Applications

July 12 - 14, 2010
Notre Dame University - Louaize, Lebanon

Technical Program

http://www.imit.kth.se/info/FOFU/ramsis/events_sum_school.html

Summary

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With Contributions From:

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The RaMSiS (Radio and Mixed Signal Integrated Systems) Group of the ICT School at the Royal Institute of Technology (KTH), Stockholm, Sweden, and the Faculty of Engineering at the Notre Dame University - Louaize (NDU), Lebanon, are pleased to announce the 6th RaMSiS Summer School. The school will be held from July 12 until July 14, 2010 in Lebanon. It will include lectures from experts in the fields of wireless semiconductors and wireless communication systems.

Description

Long gone are the days when mobile communications are restricted to voice applications. With the shift from telecom to datacom, the challenges that are arising in mobile technologies span from innovating new applications for the infrastructure that is being deployed to exploring high-performance and cost-effective techniques to implement this infrastructure.

This school targets these challenges by addressing cutting-edge mobile applications covering biomedical, traffic management, navigation and positioning as well as seamless data access on the go. It also tackles the major topics regarding the next frontiers in wireless technologies including robust digitally-assisted RF, digital/RF/power management integration, 60 GHz implementations as well as impulse radio and nanometer-scale technologies.

Target Participants

The school is intended for graduate students, undergraduate students during the advanced stages of their studies, researchers as well as design engineers and product managers at industry. Participants will be awarded 4.5 credit points according to the Swedish system upon completion of the course. Certificates of completion will also be given.

Social Activities

Besides the technical program, a very entertaining social program is planned.

Lebanon

Lebanon is a tiny country consisting of a Mediterranean coast, rugged alpine peaks and green fertile valleys. This contrast is also reflected in its diverse cultural, social and culinary qualities. From the cosmopolitan flair and vibrant nightlife of Beirut to ancient cities such as Baalbek, Byblos, Sidon, Tripoli and Tyre, Lebanon definitely keeps you coming for more.

Table of Contents

Course Instructors

Peter Händel received the M.Sc. degree in Engineering Physics and the Lic.Eng. and Ph.D. degrees in Automatic Control, all from the Department of Technology, Uppsala University, Uppsala, Sweden, in 1987, 1991, and 1993, respectively.
During 1987-88, he was a Research Assistant at The Svedberg Laboratory, Uppsala University. Between 1988 and 1993, he was a Teaching and Research Assistant at the Systems and Control Group, Uppsala University. In 1996, he was appointed as Docent at Uppsala University. During 1993-97, he was with the Research and Development Division, Ericsson Radio Systems AB, Kista, Sweden. During the academic year 96/97, Dr. Händel was a Visiting Scholar at the Signal Processing Laboratory, Tampere University of Technology, Tampere, Finland. In 1998, he was appointed as Docent at the same university. Since August 1997, he has been with the School of Electrical Engineering, Royal Institute of Technology (KTH), Stockholm, Sweden, where he currently is Professor in Signal Processing.
Dr. Händel is a former President of the IEEE Finland joint Signal Processing and Circuits and Systems Chapter. Currently he is President of the IEEE Sweden Signal Processing Chapter. He is a registered engineer (EUR ING). He has published some 35 journal articles, 60 conference papers, and holds 10 patents. He has conducted research in a wide area including design and analysis of digital and adaptive filters, measurement and estimation theory, system identification, and speech processing. Recent research interests include characterization and modeling of analog-to-digital converters and power amplifiers as well as signal processing for navigation.
He is a member of the editorial board of the EURASIP Journal of Applied Signal Processing. He is Associate Editor of the IEEE Transactions on Signal Processing. He is a member of IMEKO Technical Committee TC-4.

Waleed Khalil received his B.S.E.E. and M.S.E.E degrees from the University of Minnesota in 1992 and 1993, respectively. In 2008, he received his PhD degree in Electrical Engineering from Arizona State University. He is currently serving as an Assistant Professor at the ECE department and the ElectroScience Lab, The Ohio State University. He conducts research in RF CMOS circuits and systems for mm-wave and THz applications. Prior to joining OSU, Prof. Khalil held various technical leadership positions in both wireless and wireline groups at Intel Corp. Most recently, he was a Sr. Staff engineer leading the RF transceiver design team at Intel's Radio Operations Group. From 2000 to 2002, he led a group of engineers to develop Intel's 1st WCDMA analog front-end IC. He authored or co-authored 10 issued and several other pending patents, over 20 journal and conference papers and a book chapter on PLL design in nanometer technology. He serves in the technical program committee for the RFIC Symposium.

Mohamad Sawan was born in Lebanon, received the B.Sc. degree in 1984 from Laval University, and the Ph.D. degree in 1990 in electrical engineering, from Sherbrooke University, Canada. He joined Polytechnique Montréal in 1991, where he is currently a Professor of Microelectronics and Biomedical Engineering. His scientific interests are the design and test of mixed-signal (analog, digital, RF, MEMS and optic) circuits and Microsystems: design, integration, assembly and validations. These topics are oriented toward the biomedical and telecommunications applications. Dr. Sawan is a holder of a Canada Research Chair in Smart Medical Devices. He is leading the Microsystems Strategic Alliance of Quebec (ReSMiQ) receiving membership support from 11 Universities. He is founder / co-founder of several International conferences such as NEWCAS, BiOCAS, and ICECS, and he is Editor / Associate Editor of several International Journals such as the IEEE Transactions on Biomedical Circuits and Systems and the Springer Mixed-signal Letters. He is the founder of the Polystim Neurotechnologies Laboratory at Polytechnique Montréal. Dr. Sawan published more than 450 papers in peer reviewed journals and conference proceedings, offered more than 90 invited talks / keynotes, and he was awarded 6 patents pertaining to the field of biomedical sensors and actuators.

Dr. Sawan received several prestigious awards; the most important of them are the Medal of Honor from the President of Lebanon, the Bombardier Award for technology transfer, the Barbara Turnbull Award for medical research in Canada, and the achievement Award from the American University of Science and Technology. Dr. Sawan is Fellow of the IEEE, Fellow of the Canadian Academy of Engineering, Fellow of the Engineering Institute of Canada, and Officer of the Quebec's National Order.

Dominik Schmidt has been working in the semiconductor industry for 20 years. He was at Altera working on reconfigurable logic and has worked with Sharp, TI, Cypress, and TSMC. Among several startups, he co-founded Pixel Devices International (PDI) in 1997, one of the first companies to offer CMOS imaging chips. After PDI was acquired by Agilent, he founded Airify Communications, specializing in multi-protocol wireless chip design. Following the acquisition of Airify, Dr. Schmidt is now Director of Wireless Engineering at Intel Corporation leading efforts to come up with a next generation of advanced wireless products. He has also worked for the Stanford Linear Accelerator and Lawrence Berkeley National Laboratory on several advanced projects, and has consulted for several large companies and start-ups in the mixed-signal and RF design areas. He has taught at UC Extension since 2000 and also taught at Tsinghua University in Beijing and various other universities around the world. He has published over 40 papers and has over 80 patents granted and pending. He is currently writing a graduate textbook on RF Design for Elsevier Press.

Hermann Schumacher was born in Siegen, Germany, in 1957. He received his Diplom-Ingenieur and Doktor-Ingenieur degrees in Electrical Engineering from RWTH Aachen, Aachen, Germany in 1982 and 1986, respectively.
In 1986, Dr. Schumacher joined Bell Communications Research (Bellcore), in Red Bank, NJ, as a member of technical staff, working on InP-based optoelectronic and electronic devices.
In 1990, he accepted a position at the University of Ulm as a professor in the Department of Electron Devices and Circuits. Here, his group works on Silicon and III-V based heterostructure semiconductor devices and their applications in micro- and millimeter-wave ICs.
Since 1998, he has been the director of the Communications Technology International Master Program at the University of Ulm and received the State Teaching Award 1999 for his efforts in international education.
In 2001, Professor Schumacher set up the Competence Center on Integrated Circuits in Communications, a public-private partnership between the University of Ulm, Atmel Germany, and EADS. For this collaboration, he received Ulm University's Industry-Academia Collaboration Award in 2009.
From 2000 to 2003, he served as the University of Ulm's Vice President for Research. In 2006, he was elected member of the Academic Senate.
Professor Schumacher was the co-chair of the 2007 European Microwave IC conference (EUMIC 2007), and chaired the RF Microsystems Cluster Meeting, the European Commission's annual joint evaluation event for projects related to high-frequency microsystems, in 2006 and 2008. Together with R. Plana, he chairs the Technical Program Committee for SiRF 2010 (New Orleans, LA).

Mohammed Ismail is a Professor and Founding Director of the Analog VLSI Lab at the Ohio State University, USA and of the RaMSiS Group at KTH, SWEDEN. He is also affiliated with the ElectroScience Lab at Ohio State. Currently, he conducts research on robust low power RF and mm-wave ICs for wireless, bio and multimedia applications with a focus on manufacturable low cost high volume CMOS solutions for mobile and wearable embedded devices. He served as a Corporate Consultant to over 30 companies and is a Co-Founder of Firstpass Technologies, Inc. a developer of RF and mixed signal IPs. He Co-founded ANACAD-Egypt (now part of Mentor Graphics). He advised the work of 49 Ph.D. students and of over 90 M.S. students. He authored or co-authored a dozen books and over 250 journal publications. He received the US Presidential Young Investigator Award, the Ohio State Lumley Research Award four times, in 1992, 1997, 2002 and 2007 and the US Semiconductor Research Corporation's Inventor Recognition Award twice. He is a Fellow of IEEE.

Ana Rusu received the degrees of Diploma Engineer (M. S. degree) in Electronics and Telecommunications Engineering from Technical University of Iasi, Romania, in 1983, Ph.D. in electronics engineering from Technical University of Cluj-Napoca, Romania, in 1998 and Docent in Circuit Theory from Royal Institute of Technology Stockholm, Sweden in 2006. Since September 2001, she has been with the Royal Institute of Technology (KTH), Stockholm, Sweden, where she is Associate Professor in the RaMSiS group/Integrated Devices and Circuits/School of ICT. Her research interests include low-voltage low-power RF/AMS circuits and systems design, EDA/CAD tools for wireless communications; digitally-enhancement techniques of RF/analog; SDR/CR/SR technology and applications; traffic management systems; wireless sensor networks. She has participated in several national and international research projects and has authored or coauthored more than 100 international scientific publications in journals, books, book chapters and conference proceedings.

Saúl Rodríguez Dueñas received the B.Sc. degree in electrical engineering from the Army Polytechnic School (ESPE), Quito, Ecuador in 2001. He received the M.Sc. degree in System-on-Chip Design in 2005 and the Ph.D. degree in Electronic and Computer Systems in 2009 from the Royal Institute of Technology (KTH), Stockholm, Sweden. He currently holds a post-doctoral researcher position at the RaMSiS group (KTH). His research area covers high speed CMOS circuit design for wideband radio front-ends. His main interests are low-voltage nanometer radio circuit design for mobile communications.

Jad G. Atallah is a faculty member at the Department of Electrical, Computer & Communication Engineering, Faculty of Engineering, Notre Dame University - Louaize (NDU), Lebanon. He received the B.E. degree in Computer and Communications Engineering (With Distinction) from The American University of Beirut (AUB), Lebanon, in 2001. He also received the M.Sc. degree in Electrical Engineering in 2003 with specialization in System-on-Chip Design and the Ph.D. degree in Electronic and Computer Systems in 2008 within the RaMSiS group from The Royal Institute of Technology (KTH), Sweden. His current research interests are in RF/analog/mixed-signal designs, especially frequency synthesizers, for multi-standard wireless communications and in solutions for vertical handover in future communication systems.

Course Schedule

July 12	
8:00 - 8:30	Registration and Coffee
8:30 - 9:00	**School Introduction** Mohammed Ismail, KTH, Sweden and Elias Nassar, NDU, Lebanon
9:00 - 10:30	**Frontend and Analog Signal Processing for Ultra-Wideband Impulse Radio Applications** Hermann Schumacher, Ulm University, Germany
10:30 - 11:00	Coffee Break
11:00 - 12:30	**Wideband Nanometer CMOS RF Front-End** Saúl Rodríguez Dueñas, KTH, Sweden
12:30 - 1:30	Lunch
1:30 - 3:00	**Receiver Design for Multi-GBit/s Short-Range Communication Systems at 60 GHz** Hermann Schumacher, Ulm University, Germany
3:00 - 3:30	Coffee Break
3:30 - 5:00	**BIST and Digital Self-Calibration of RF and mm-Wave ICs** Mohammed Ismail, KTH, Sweden
7:00 -	**Course photo and Social Activity**

July 13	
9:00 - 9:45	**Millimeter-Wave Circuits: Embracing the Next Wave of Wireless Communication** Waleed Khalil, OSU, USA
9:45 - 10:30	**"Dirty" Radio Signal Processing** Peter Händel, KTH, Sweden
10:30 - 11:00	Coffee Break
11:00 - 12:00	**Wideband High Speed ADCs for Emerging Wireless Applications** Ana Rusu, KTH, Sweden
12:00 - 12:30	**4G Wireless Device Optimization through Advanced CMOS Process Integration - Part I** Dominik Schmidt, Intel Corporation, USA
12:30 - 1:30	Lunch
1:30 - 3:00	**Emerging Wireless Intracortical Massively Parallel Biosensing** Mohamad Sawan, Polytechnique Montréal, Canada
3:00 - 3:30	Coffee Break
3:30 - 5:00	**Challenges in Future Mobile Communications and the Role of Wireless Sniffers** Jad G. Atallah, NDU, Lebanon
7:00 -	**Social Activity**

July 14	
9:00 - 9:45	**Si/SiGe BiCMOS Microwave and Millimeter-Wave ICs with High Functionality** Hermann Schumacher, Ulm University, Germany
9:45 - 10:30	**Millimeter-Wave RF Front-End ICs** Waleed Khalil, OSU, USA
10:30 - 11:00	Coffee Break
11:00 - 11:45	**Real-Time Traffic Information Systems for Vehicle Navigation** Ana Rusu, KTH, Sweden
11:45 - 12:30	**Future Navigation and Positioning** Peter Händel, KTH, Sweden
12:30 - 1:30	Lunch
1:30 - 2:30	**Wireless Brain-Machine Interface for the Recovery of Neural Vital Functions** Mohamad Sawan, Polytechnique Montréal, Canada
2:30 - 3:30	**4G Wireless Device Optimization through Advanced CMOS Process Integration - Part II** Dominik Schmidt, Intel Corporation, USA
3:30 - 4:00	Coffee Break, Course Evaluations and Wrap-Up, Certificates of Completion
4:00 - 5:00	**Panel Session**

Lectures Abstracts

Frontend and Analog Signal Processing for Ultra-Wideband Impulse Radio Applications

Hermann Schumacher

When the US Federal Communications Commission opened up a frequency band from 3.1 to 10.6 GHz for unlicensed use with low spectral power density, it triggered a flurry of academic and industrial activity. For several years, most of the activities concentrated on wideband OFDM systems intended for ultra-highspeed wireless LAN applications. With the demise of the WiMedia consortium in 2009, attention refocused on impulse radio techniques, which have been shown to be an ideal candidate for high precision location, movement detection, and also low-power sensor node networks.

The Ulm University group has been actively researching impulse radio circuits since 2004. The presentation will introduce their highly compact transmitter designs, as well as both correlation and energy detection receiver concepts. Applications in health care (vital sign detection, wireless sensor nodes) will also be covered in the lecture.

Especially the section on receiver design will provide information of interest not just for impulse radio systems, but for everyone interested in low-noise receivers covering wide frequency bands, such as those required for emerging cognitive radio systems.

Wideband Nanometer CMOS RF Front-End

Saúl Rodríguez Dueñas

Signals in electrical networks can be described by using Kirchhoff's voltage and current laws. Accordingly, node voltages and branch currents completely define the characteristics of a circuit. The relative ease of simulating and measuring voltages has resulted in an abundant number of circuits designed to process information signals only in voltage domain. On the other hand, circuits processing signals in currents require breaking the circuit in order to measure currents, hence, making these designs less attractive. The RFIC design has been dominated by the use of voltage-mode circuits. The scaling of the devices and the unavoidable reduction of power supply voltages below 1V has however caused a challenging problem since clipping distortion becomes the dominant cause of gain compression at the receiver front-end. Alternatively, it is possible to use current-mode circuits. This lecture shows the fundamentals of voltage and current mode amplification and compares the advantages and disadvantages of each technique when used in RF receiver front-ends. A receiver front-end that targets WiMAX/LTE standards using current-mode technology will be presented as an example.

Receiver Design for Multi-GBit/s Short-Range Communication Systems at 60 GHz

Hermann Schumacher

Recent advances in Si BiCMOS technologies have made commercial use of the 60 GHz band (57-64 GHz in Europe) a hot topic for ultra-high data rate applications such as linking HDTV sets and mass storage devices. One of the demonstrators in the German EASY-A research project targets 10 GBit/s over 3 meters. Ulm University is responsible for the receiver part.

The experiences gained in this ongoing project will be used to discuss the design of 60 GHz receiver frontends, but especially the analog signal processing architecture chosen, operating at an intermediate frequency of 5 GHz. Analog signal processing and a relatively simple modulation scheme (DE-QPSK) were chosen because high-speed analog-to-digital converters with the required resolution are at present much too expensive for commercial use, and require a very large amount of power.

BIST and Digital Self-Calibration of RF and mm-Wave ICs

Mohammed Ismail

To achieve the highest performance/price ratios of a handheld wireless device, the current trends in wireless chip set development call for multi-standard nanometer CMOS radios integrated on a single chip. This represents a grand challenge to the yield of such chip sets and typically requires several silicon spins which will increase the NRE development costs and may result in significant product delays and in missing important market windows. To meet this challenge we present design techniques for built-in self-test (BIST) and digital self calibration of multi-band, multi-mode CMOS radio systems and demonstrate the validity of these techniques in the design of WiMAX/LTE CMOS radio front ends. The presentation will also review the basic principles of zero-IF CMOS multi-band, multi-mode radios from antenna to bits and will present circuit techniques for mm-wave (60GHz) applications in nanometer CMOS.

The talk will be given at an introductory level. So newcomers to the field will be welcome.

The material will cover the following main topics:

- Evolution of the wireless technology beyond 3G
- The nanometer CMOS RF radio design problem
- Built-in self-test and self aware RFIC design
- Digital self-calibration techniques
- Case studies of an RF front-end for WiMAX/LTE

Millimeter-Wave Circuits: Embracing the Next Wave of Wireless Communication Millimeter-Wave RF Front-End ICs

Waleed Khalil

MM-Wave wireless systems are proliferating into a broad range of applications such as: Giga Hz wireless, imaging and security, automotive radars, and weather radar systems. As future wireless radios continue to push the available bandwidth and shift to mm-wave range, RF CMOS is expected to remain the predominant technology. The significant increase in operating frequency (few GHz to 10s of GHz) is a barrier that RF CMOS designers are willing to challenge. This talk will first introduce some recent advancement in mm-wave and discuss some of the challenges in both circuits and systems design. The second part of this talk will introduce novel mm-wave front-end module technology with sophisticated beam steering capabilities. While considerable attention has been paid to mm-wave integrated circuits for advances in CMOS transceivers, a clear need exists for affordable

approaches to combine antenna arrays, phase shifters and RF circuitry into single or multi-module packages. The proposed beam steering circuits present a miniature, low-loss and low-cost volumetrically scanning arrays employing phase shifters, antenna array and feed network on the same substrate, thus delivering a compelling phased-array solution for mm-wave and sub-mm wave applications.

"Dirty" Radio Signal Processing

Peter Händel

Digital signal processing techniques are heavily used in wireless systems in order to increase data-rates and the effective use of the available spectrum. Each new generation of wireless standards increases the requirements of the analog radio frequency (RF) hardware. This increases the cost and power consumption of the equipment. A new research trend is to reduce the power consumption – also known as "green-radio". One way of leveraging such improvements is to use digital signal processing techniques to compensate for the impairments of analog components in digital base-band. This is known as the dirty-radio paradigm. A few works are already available in the area; however, the volume is still very modest in comparison with the thousands of articles that propose techniques that require ever-increasing performance of analog components. In this seminar, digital signal processing techniques for combating the imperfections introduced by analog-digital converters, power amplifiers, IQ-mixers, etc are presented.

4G Wireless Device Optimization through Advanced CMOS Process Integration

Dominik Schmidt

The new devices now planned for LTE and multicom face an increasing set of power-performance constraints. The application processor is approaching PC-like requirements and the wireless subsystem is running at a very high data rates. To make this possible while also reducing cost and maintaining constant active and standby power requires drastic changes in the CMOS process architecture. This presentation will outline novel ways to integrate the highest performance microprocessors with RF/PM (Power Management) circuits on the same monolithic substrate.

Wideband High Speed ADCs for Emerging Wireless Applications

Ana Rusu

Next generation mobile wireless systems will have to support a wide range of data rates over several signal bandwidths and will require flexible system resources. The analog-to-digital converter (ADC) is a key component in such wireless systems. This lecture will provide an overview of the wideband high speed analog-to-digital conversion technologies for emerging wireless mobile applications. Design challenges, such as degree of configurability and adaptability and reduction in power dissipation, size and cost, will be introduced. The lecture will also discuss the key design challenges for nanometer CMOS technologies and digital enhancement algorithms and techniques which allow the design of robust high performance nanometer CMOS ADCs will be presented.

Emerging Wireless Intracortical Massively Parallel Biosensing

Mohamad Sawan

Currently emerging intracortical biosensing applications are a promising alternative to allow learning about the cortical organization, studying the neural activity underlying cognitive functions and pathologies, locating onset seizures, understanding neurons interactions, detecting mind driven decisions, etc. This talk covers circuit and packaging techniques used for the design and integration of biosensing Microsystems. Such devices are interconnected to intracortical neural tissues, and include low-power high-reliability wireless link used to power up such implanted devices and bidirectionally exchange data with external base station. Global view of typical devices altogether with corresponding multidimensional challenges will be described. In addition, special attention will be paid to automatic detection of neural interaction and to massively parallel recording of action potentials, through large arrays of electrodes and power management of these bioelectronic devices.

Challenges in Future Mobile Communications and the Role of Wireless Sniffers

Jad G. Atallah

Mobile wireless standards are conceived based on a set of compromises that are made depending on the targeted applications. This is due to the tradeoffs that inherently exist in the design and optimization of these systems. This talk starts by exploring these tradeoffs in order to project the future state of wireless systems. As a result, it will be shown that future wireless solutions will involve a multitude of network standards between which the user can switch in order to optimize a set of benefits such as cost and performance. This can be achieved using the proposed Sniffer-based architecture. Towards that end, the hardware design of the mobile device will involve knowledge about the requirements imposed by the upper communication layers. This talk continues by presenting some of these requirements for WLAN, WiMAX and 3G standards as they pertain to the mobile transceiver front-end design. The focus then shifts towards the design of multi-band, multi-mode frequency synthesizers as being a central block of the Sniffer architecture and of software-defined radios that support dynamic spectrum allocation, starting from the system level and going down to silicon.

Si/SiGe BiCMOS Microwave and Millimeter-Wave ICs with High Functionality

Hermann Schumacher

The advantages of Si-based technologies for micro- and millimeter-wave applications are realized if and only if their ability for higher complexity of group III-V semiconductor technologies are being exploited.

The lecture will briefly look at the economics of micro- and millimeter-wave systems and make the point that RFCMOS is not always the most cost-effective solution. It will then discuss issues of on-chip crosstalk, introduce decoupling measures, and finally evaluate several examples of highly multi-functional ICs, from own research and from current literature.

Real-Time Traffic Information Systems for Vehicle Navigation

Ana Rusu

People and the environment can certainly benefit greatly from a real-time traffic information system that finds the optimum path for a vehicle driver to go from one location to another location. The future traffic information system should make use of existing wireless infrastructures and should be upgraded to enable seamless integration of such system. This lecture will present the state-of-the art approaches, solutions and technologies for developing advanced traffic information systems for vehicle navigation. The use of GPS enabled mobile phones allows the replacement of the sensor network with autonomous sensors reporting to traffic management software integrated into base stations of commercial mobile service providers. Moreover, the use of Software Defined Radio and Cognitive Radio technologies allows an efficient use of radio resources. The issues, challenges and benefits of such real-time traffic information system will be also discussed.

Future Navigation and Positioning

Peter Händel

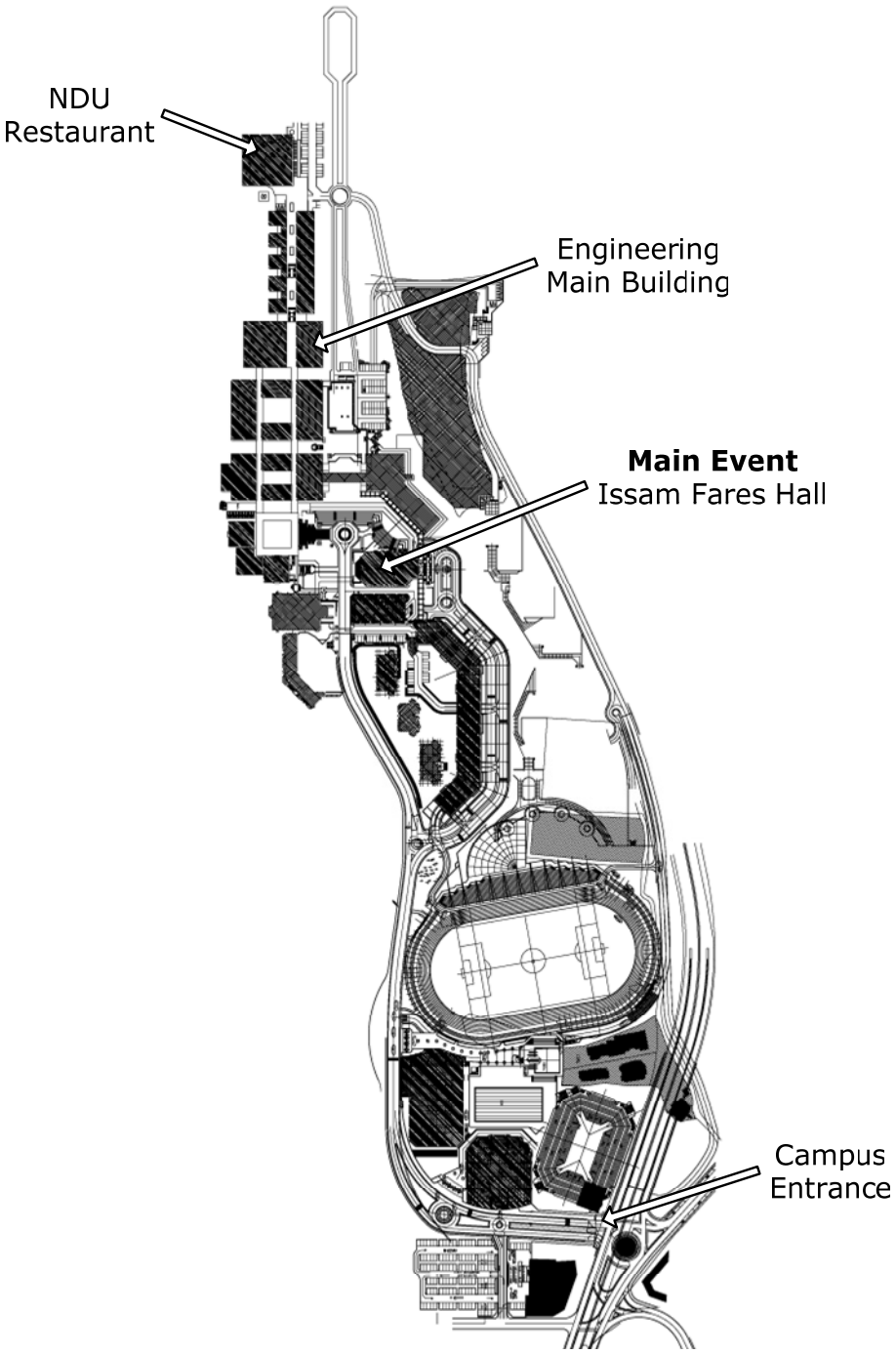
Navigation and positioning using low-cost GPS receivers has had a tremendous effect on the modern society. Nowadays, GPS chip-sets can be found in a variety of applications. In this lecture, the basis of positioning and navigation is outlined. Positioning technologies based on stand-alone GPS receivers are vulnerable because of the low signal levels and a requirement on line-of-sight and, thus, have to be supported by additional information sources to obtain the desired accuracy, integrity, availability, and continuity of service. The area of high-performance navigation for vehicles (ground, sea, underwater, or air) is well developed. Nowadays, the challenge is to develop high-performance navigation system solutions using low-cost sensor technology, or systems for pedestrian positioning and navigation.

Wireless Brain-Machine Interface for the Recovery of Neural Vital Functions

Mohamad Sawan

Intracortical medical actuators such as electrical direct microstimulators and drug delivery biochips are emerging brain-machine interfaces to address complex central neural system dysfunctions. The most important of them are dedicated to the recovery of neural functions, such as Parkinson diseases, hearing senses by cochlear implants, hands and legs movement by neuromotor prostheses, etc. This talk covers circuit and system techniques for the implementation, integration and packaging of Microsystems dedicated to microstimulation in the primary visual cortex, which are intended to recover vision for the blind through a multisite large arrays of electrodes and power management of these bioelectronic devices. Very-low-power mixed-signal (low voltage, high voltage, analog, digital and RF) building blocks, used to implement the various parts of these Microsystems, will be described. Also, high-reliability wireless links are key blocks intended to power up such implanted devices while external imaging system wirelessly transmits to these Microsystems all required data for microstimulation.

NDU Campus Map



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