Korean-Swiss Science Days

Nano-Tera.ch Joint Switzerland-Korea Symposium on

Novel trends at the frontier of computing and electronics

May 7-8, 2013 • BC420, EPFL

Final Report

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE
VICE PRESIDENCY FOR ACADEMIC AFFAIRS
INTERNATIONAL RELATIONS

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Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich
Bilateral Korean-Swiss Science and Technology Program


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Korean - Swiss Science Days
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EPFL
ETH
Nano-Tera

Synthesis

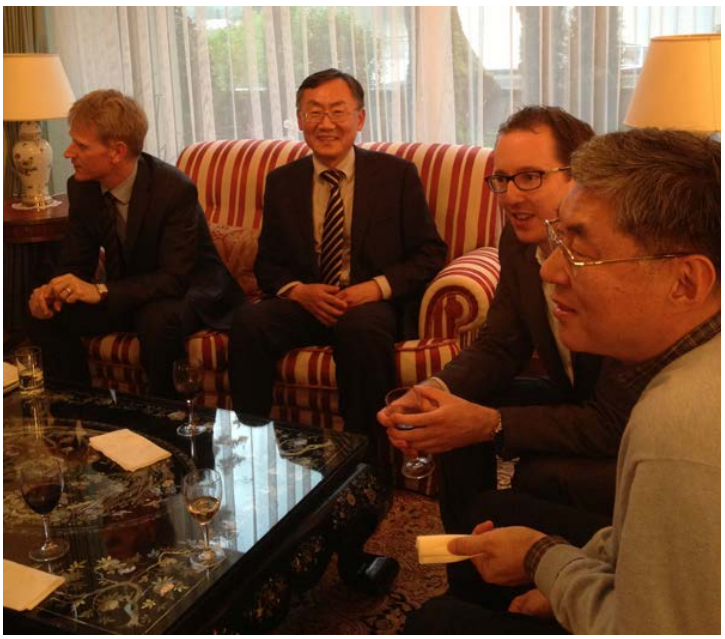
The 4th Korean Swiss Science Days were held at EPFL on 6-8 May 2013 and were a big success. The Science Days have been held yearly alternating in Korea and Switzerland since 2010 and are an integral part of the bilateral Korean-Swiss Science and Technology Program. This year's edition was jointly organized by EPFL's International Relations, Nano-Tera.ch responsible for the scientific content and ETH Zurich as the Swiss Leading House. The Science Days were financed with a conference grant from Nano-Tera.ch and from the bilateral program through ETH Zurich and the Korean National Research Foundation (NRF). 75 participants from Korea and Switzerland registered and 17 posters were displayed.

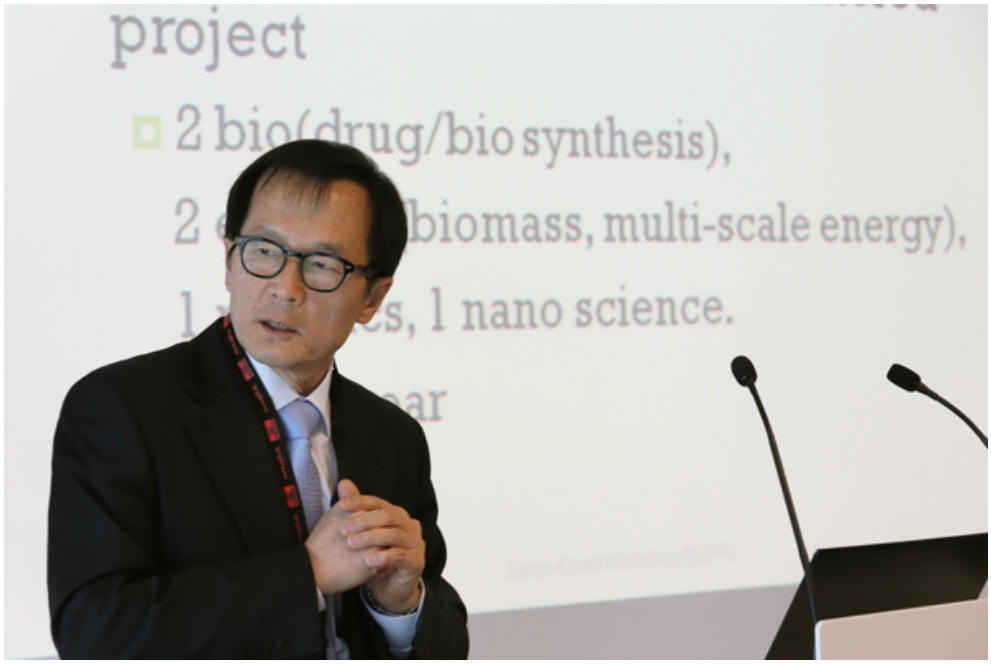
The Science Days opened directly with a highlight, the welcome dinner at the Korean Ambassador's Mr. YoungHan Bae Residence in Bern on May 6. The two following days saw a series of lectures within four key topics: 1) bio-sensing and health management, 2) energy-aware electronics, 3) architectures and networks for the Internet of things, and 4) emerging devices. Key note speeches were given by Prof. Lothar Thiele from ETH Zurich and Prof. Chong-Min Kyung from the Korea Advanced Institute of Science and Technology (KAIST). The other talks included outstanding speakers from EPFL, ETH Zurich and CSEM on the Swiss side and from KAIST, Seoul National University (SNU) and Yonsei University on the Korean side. Speakers from LG Electronics Ltd and Samsung Advanced Institute of Technology (SAIT) complemented the program from the private industry perspective. A presentation by Dr. Jean-Luc Barras from the Swiss National Science Foundation gave an insight into the available grants and instruments for cooperation between Korea and Switzerland. He emphasized that funding is heavily dependent on the demand voiced by researchers and that new instruments can be specifically designed to match the needs.

The purpose of the Science Days to increase scientific collaboration between the two countries was clearly met, in particular because of the match of interests between the Nano-Tera.ch and the Korean scientists. The lively discussions after the talks and during the social spaces demonstrated the large interest in each other's research, and representatives from KAIST offered to host the next Sciences Days in 2014 at their institution. Several Korean participants also visited EPFL laboratories after the symposium to discuss cooperation opportunities. Prof. De Micheli from Nano-Tera.ch reported an invitation of the Swiss scientists to the annual symposium of the Center for Integrated Smarter Sensors (CISS) in October 2013 in Korea led by Prof. Chong Min Kyung of KAIST. During the symposium, they will discuss further cooperation to create a win-win situation. Nano-Tera also suggested the creation of a broader collaborative research ecosystem with Korea and possible topics for the joint research agenda between the countries.

In conclusion, the Science Days were a high level event that also attracted many Swiss researchers from various institutions including the Universities of Applied Sciences to participate. They also provided a platform for students to present their research to the Korean partners. Unfortunately, the participation of Korean students was only marginal despite the offered travel grants, it is hoped that it will be easier to include them in a next edition of the Science Days in Korea.

Some pictures of the event




project
2 bio(drug/bio synthesis),
biomass, multi-scale energy),
s, 1 nano science.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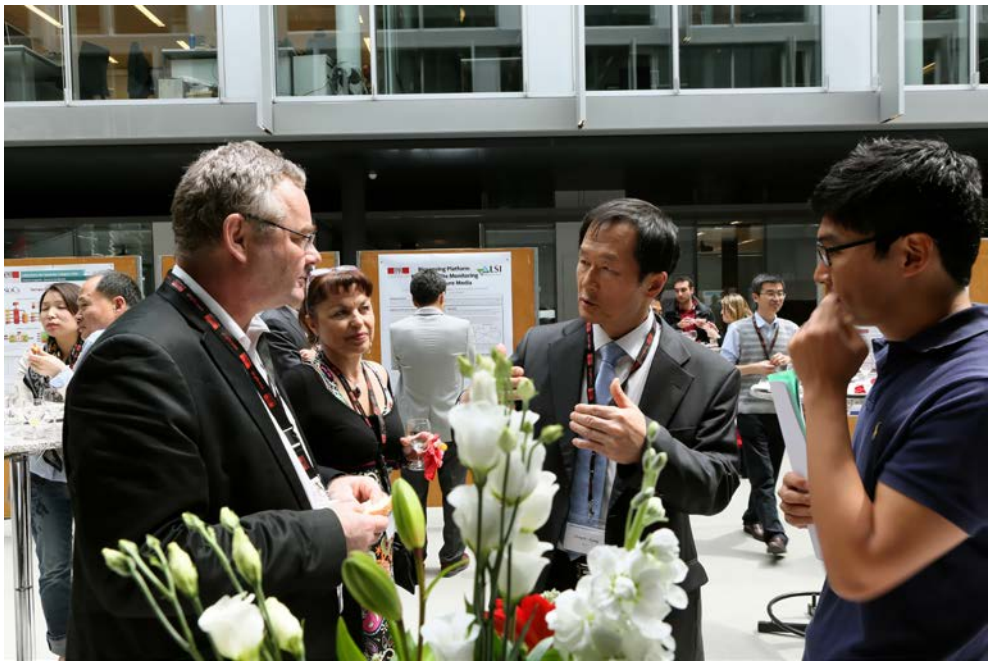


Swiss Research Program
Engineering Multi-Scale
Systems for Health, Security,
Energy and the Environment

Participants' Comments

Prof. Giovanni De Micheli, EPFL
It was an excellent meeting with high-level participation and very good communication bandwidth. I think there is a strong synergy in interests and in research strength.
이번행사가 한-스위스 양자간에 발전에 시너지 효과를 가져다 줄것이라 생각합니다.

Prof. Hoi-Jun Yoo, KAIST
오래 전부터 자매결연 학교였던 KAIST와 EPFL이 이렇게 만나게 되어 좋고, 학교 대 학교가 아니라 더 큰 그을 보고 발전해 나가면 스위스와 우리나라 모두에 도움이 될 거다.
It was a pleasure to visit EPFL which has been having a partnership with KAIST for a long time. Beyond the relations between the universities, it would be very helpful to have broad collaborations between both Korea and Switzerland.

Prof. Yusuf Leblebici, EPFL
Very successful, happy.
행사가 매우 성공적이 였고, 재미있었습니다.

Prof. Yang-Kyu Choi, KAIST
EPFL 학교에 대한 좋은 생각을 했고, 스위스도 참 좋은 나라임을 새삼 느꼈다.
EPFL is a good education and research school. Switzerland is good country, as well.

Prof. Sun Kim, SNU
이런 만남이 한 번으로 끝나는 게 아니라, 종종 만나면서 점차 방향을 잡아가면 좋겠다.
It should not end with one meeting. Several meetings are necessary to move forward with setting some goals together.

Sungwoo Hwang, Samsung
EPFL이라는 학교에 대해서도 더 잘 알 수 있는 계기였고, 개인적으로 만나고 싶던 분과 친구를 맺을 수 있는 기회도 되어 좋았다.
It was a good chance to know about EPFL better. I am happy because I could make a friend with a person who I was hoping to meet.

Prof. Chong-Min Kyung, KAIST
EPFL 의 시도하려는 프로젝트가 실용적이고 자유분방하고 종래의 연구와 다른 것 같아 한국이 앞으로 나아가려는 방향과 비슷함을 느껴 반가웠고, 앞으로 협력을 하면 서로 발전 하는 데 도움이 많이 될 거다. 한국이 해결하려는 문제에 대한 의식이 많이 발전 한 것 같다.
EPFL projects are practical and even original. It seems different from standard research. I was glad to see that they are similar to the way how we (Korean researchers) have been trying. If we cooperate, it would be very helpful for developing collaborations.

Prof. Ki-young Choi, SNU
굉장히 여러 방면으로 좋았고, 단순히 일회성 행사로 끝나지 않고 앞으로 더 적극적인 협력이 이루어질 수 있는 방향으로 나아가길 바란다.
Everything was very good. I wish this symposium does not end up being a one time event and can lead to more active scientific collaborations in the future.

Yoon Ho Choi, LG
한 분야만 보다가 폭넓음을 보았다. 나의 전문분야를 넘어 우물 안에서 벗어남을 또 한 번 느꼈다. 스위스와 한국간의 비슷한 점도 나름 느꼈고, 서로 교류하면 좋겠다.
I usually focus on my own research. Here, I enjoy learning about other types of research in my field. Also, there are several similarities between Switzerland and Korea. I wish to have more scientific exchange between Korea and Switzerland.

Pearl Pu
I learned a lot about nano technology research in Korea. Great event. I will attend again.
한국 나노 테크놀로지에 대해 많은 것을 배울 수 있었습니다. 다음행사에도 꼭 참석할 것입니다.

Martin Rajman
Broad list of topics covered by the presentations which fosters good multidisciplinary discussions.
이번 행사에서 다양한 주제가 논의 되었고 학제간 연구 발전 장을 마련했다고 생각합니다

Miji Kim
한국 교수님들, 스위스 사람들을 여럿 만날 수 있는 자리였고 강의도 유익했다. 강의는 유익했지만 좀 더 본래 큰 topic 에 어울리고 강연들이 좀 더 연계되면 좋겠다.
The presentations were useful. During the symposium, I could meet many different professors and researchers from Korea and Switzerland. However, it would have been helpful to better connect related presentations in the program.

Jung hyun Ahn
관련된 전공이 아님에도 불구하고, 저명하신 교수님들로부터 한 자리에서 많은 것을 배울 수 있어 좋았다.
Even though the topic was not related to my major field, I could learn many things from the outstanding professors.

Cristina Boero
It would be interesting to evaluate opportunities for cooperation between Switzerland and Korea. I hope this will be tackled in the second day of the workshop. Maybe a brainstorming session should be organized, or face-to-face meeting in the labs?
한-스위스 나노테크 심포지움에 대해 함께 평가할 수 있는 기회를 가졌으면 합니다. 브레인스토밍 세션이 행사전에 개최되면 좋겠습니다.

Bernhard Egger
Interesting topics; good talks. Timing is not optimal (middle of the semester).
심포지움이 학기 중간에 개최되어 시기선택이 적절하지 않다고 생각합니다.

Nano-Tera.ch Joint Switzerland-Korea Symposium on

Novel trends at the frontier of computing and electronics

A yearly joint Swiss-Korean Symposium alternately held in Switzerland and Korea has been organized since 2010. The 2013 edition is hosted by EPFL and brings together major scientists from Korea and Switzerland to present their research, addressing the following key topics:

- Bio-sensing and Health management
- Energy-aware electronics
- Architectures and networks for the Internet of Things
- Emerging devices

Tuesday, May 7, 2013

08.30 – *welcome coffee & registration* –
08.45 Welcome address
09.00 Giovanni De Micheli (EPFL) – *Introduction to Nano-Tera.ch: Cyberphysical systems for health and the environment*
09.30 Keynote speech: Lothar Thiele (ETHZ) – *Towards Trustworthy Sensor Networks*
10.30 – *break* –
10.45 Hoi-Jun Yoo (KAIST) – *Wearable Sensor, Network, and Healthcare*
11.15 Yusuf Leblebici (EPFL) – *Ultra-low-power circuit techniques for implanted/medical applications*
11.45 Christofer Hierold (ETHZ) – *Carbon Nanotube Sensors*
12.15 – *lunch + poster session* –
14.00 Alex Dommann (CSEM) – *Nexray: Network of Integrated Miniaturized X-ray Systems Operating in Complex Environments*
14.30 Yang-Kyu Choi (KAIST) – *Transistor Based Biosensors*
15.00 Sun Kim (SNU) – *BioVLAB: A bioinformatics system infrastructure based on cloud computing and graphical workflow composers*
15.30 – *break* –
16.00 Sungwoo Hwang (Samsung) – *Introduction to Samsung Advanced Institute of Technology: Bringing nano-science into engineering*
16.30 Friedemann Mattern (ETHZ) – *The Internet of Things: from an academic dream to commercial reality*
17.00 Songkuk Kim (Yonsei University) – *Cloud services in the mobile computing era*
17.30 – *apero + poster session* –

Wednesday, May 8, 2013

08.30 – *coffee* –
08.45 Introduction: Funding opportunities for Korean-Swiss cooperation
09.15 Keynote speech: Chong-Min Kyung (KAIST) – *On the Design of a Smart Sensor Project*
10.15 Giovanni De Micheli (EPFL) – *Nanosystems: technology, devices, circuits and applications*
10.45 – *break* –
11.15 Kiyoung Choi (SNU) – *Using STT-RAM for Low-Power Cache*
11.45 Carlotta Guiducci (EPFL) – *Perspectives and challenges of biosensor integration*
12.15 Yoon Ho Choi (LG) – *R&D activities on emerging materials and devices at LG Electronics*
12.45 – *end* –

This symposium is organized and supported by the International Relations of EPFL, Nano-Tera.ch and the Bilateral Korean-Swiss Science and Technology Program, an initiative between the Swiss State Secretariat for Education Research and Innovation (SERI) and the Korean Ministry of Education, Science and Technology (MEST), managed by ETH Zurich and the Korean National Research Foundation (NRF).

Tuesday, May 7, 2013

09:00

Cyberphysical systems for health and the environment

Giovanni De Micheli

EPFL

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Several important societal and economic world problems can be addressed by the smart use of technology. The last forty years have witnessed the realization of computational systems and networks, rooted in our ability of crafting complex integrated circuits out of billions of transistors. Nowadays, the ability of mastering materials at the molecular level and their interaction with living matter opens up unforeseeable horizons. Networking biological sensors through body-area, ad hoc and standard communication networks boosts the intrinsic power of local measurements, and allows us to reach new standards in health and environment management, with positive fallout on security of individuals and communities. This talk reviews the Nano-Tera.ch research program, addressing the enabling and disruptive technologies that stem from the combination of nano technology with large (tera) -scale information and communication systems.

09:30

Towards Trustworthy Sensor Networks

***Lothar Thiele*, Jan Beutel, Bernhard Buchli, David Hasenfratz, Federico Ferrari, Matthias Keller, Roman Lim, Olga Saukh, Felix Sutton, Marco Zimmerling**

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The area of wireless sensor networks had a huge impact on the research in various fields related to electrical engineering and computer science. Spatially distributed sensor nodes are used as a new kind of measurement instruments to collect physical or environmental data. Much of this work was driven by the early vision of SmartDust. One of the corner stones to achieve the required quality of service in terms of sensing density in time and space was the concept of 'reliability via over-provisioning'. The field of wireless sensor networks is now in a stage where serious applications of societal and economic importance are in reach such as industrial process monitoring and control, environment monitoring, logistics, healthcare applications, home automation, and traffic control. In many of these applications, all measurements are precious and must not be lost, reliable data must arrive in real-time, sensors are relatively expensive, and deployment of a sensor network and repair/update are very labor-intensive and expensive. We argue that in order to significantly advance the application domains by using a wireless sensor network as a novel means of observation and interaction, it is inevitable that such a tool be created as a quality scientific instrument with known and predictable properties. The talk will introduce new models and methods that lead to predictable and efficient networked embedded systems such as optimized and predictable use of harvested solar energy, data cleaning methods, network tomography, sensor calibration, and new classes of dependable synchronization and communication protocols. We will demonstrate their use in extensive, long-term installations of sensor networks in hostile environments for safety-critical applications (mobile air quality measurements in cities and environmental sensing in permafrost regions).

10:45

Wearable Sensor, Network, and Healthcare

Hoi-Jun Yoo

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Compact and convenient healthcare systems made of CMOS IC are opening the low cost ubiquitous healthcare services. Healthcare systems, such as portable, wearable and implantable, are analyzed, and the signals, circuits and systems from the body to the LAN or other public networks are examined. The compact CMOS circuits for the sensor read-out, ADC, ultra-low power platform, and wireless communication will be explained. The packaging technology, especially wearable forms, is important for user's convenience. Fabric will be used extensively as the system integration substrate, and a new integration scheme by which the CMOS ICs will be directly bonded on the fabric, will be introduced. Some system examples including Bandage type body signal monitors, Sleep monitoring system, Smart Acupuncture systems and Transdermal Drug Delivery system, will be explained.

11:15

Ultra-low-power circuit techniques for implanted/medical applications

Yusuf Leblebici

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In this talk, a novel approach is presented for implementing ultra-low-power digital and mixed-signal components and systems using source-coupled logic (SCL) circuit topology, operating in weak inversion (subthreshold) regime. Minimum size pMOS transistors with shorted drain-substrate contacts are used as gate-controlled, very high resistivity load devices. Based on the proposed approach, the power consumption and the operation frequency of logic circuits can be scaled down linearly by changing the tail bias current of SCL gates over a very wide range spanning several orders of magnitude, which is not achievable in subthreshold CMOS circuits. Measurements in conventional 0.18um and 90nm technologies show that the tail bias current of each gate can be set as low as 10 pA, with a supply voltage of 300 mV, resulting in a power-delay product of less than 1 fJ per gate. Complex digital blocks such as parallel / pipelined adders and multipliers designed by using the STSCL topology will be presented - as well as some examples of mixed-signal blocks, e.g. ultra-low power A/D converters for medical and implanted applications.

11:45

Carbon Nanotube Sensors

***Christofer Hierold*, Matthias Muoth, Miro Haluška, Stuart Truax, Cosmin Roman**

ETH Zurich, Department of Mechanical and Process Engineering, Micro and Nanosystems
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Carbon nanotubes exhibit a number of excellent mechanical and electronic properties. In particular single walled carbon nanotubes (SWNT) are known for their band gap modulation due to mechanical strain [1], or electronic property-changes due to interaction with surrounding molecules, but also for their ultra-low power consumption if used as functional materials in sensors. However, successful technology transfer to production and development of affordable products based on SWNTs is threatened by the lack of solutions for their fabrication and integration. We present results on individual SWNTs as functional material in field effect transistors, mechanical and chemical sensors. We discuss the influence of process variations on the properties of SWNT devices, and options for sensor fabrication [2].

[1] M. Muoth, C. Kiran, Y. Liu, and C. Hierold, "Suspended CNT-FET piezoresistive strain gauges: Chirality assignment and quantitative analysis," in IEEE MEMS 2013, Taipei, Taiwan, 2013, pp. 496-499.

[2] M. Muoth, T. Helbling, L. Durrer, S. W. Lee, C. Roman, and C. Hierold, "Hysteresis-free operation of suspended carbon nanotube transistors," Nature Nanotechnology, vol. 5, pp. 589-592, 2010.

14:00

Nexray: Network of Integrated Miniaturized X-ray Systems Operating in Complex Environments

Alex Dommann

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NEXRAY targets radically new approaches to X-ray imaging, e.g. for static tomography without any moving parts, which makes the acquisition of medical CTs much faster, easier and cheaper. The prototype components contain miniaturised X-ray sources based on carbon nanotube (CNT) cold electron emitters combined with advanced microsystems packaging technology, together with X-ray direct detectors based on crystalline Germanium absorption layers integrated in CMOS sensor chips. The project aroused interest from numerous companies, among them Philips Healthcare and Comet; and from research institutions like CERN or the CUBEWATCH satellite consortium for X-ray astronomy.

The feasibility of the proposed challenges could be proven on the source and the detector side, including several highlights: On the detector side a real breakthrough was achieved. Extremely thick (> 50 μm) Germanium absorption layers can be grown monolithically on CMOS processed Silicon wafers, thus eliminating the need for expensive and technologically critical bump bonding techniques. These unrivalled results, published in the March 16th 2012 issue of the prestigious Science magazine and selected as the cover story of the same issue, generated ample press coverage and international reactions. A newly founded start-up company PileGrowTech srl will commercialise this novel technique. The full detector processing sequence and the required CMOS circuit to detect single X-ray photons are established and tested, and X-rays could be detected.

A miniaturised source based on a novel CNT flip-chip production method with minimally required extraction fields and vacuum tight, MEMS based packaging technologies is also available as a prototype. The packaging technology was successfully able to hold a vacuum level of $\leq 10^{-3}$ mbar. X-ray generation was proven on dental X-ray films with acceleration voltages of 5 kV. For safety reasons these tests were still performed in a vacuum chamber.

14:30

Transistor Based Biosensors

Yang-Kyu Choi, Chang-Hoon Kim, Jae-Hyuk Ahn, Jee-Yeon Kim

Department of Electrical Engineering, KAIST, Yuseong-gu, Daejeon, 305-701, Korea
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Microelectronics based on silicon devices has been remarkably developed according to Moore's law for past four decades. The essential progress has been achieved by miniaturization. But, such down-scaling comes to an end in a semiconductor roadmap, especially in a field of logic and memory by employment of CMOS (Complementary-Metal-Oxide-Semiconductor) technology. Thus it is timely to exploit another application, which can fully utilize the CMOS technology. A transistor based biosensor can be a breakthrough to open a new area by use of matured CMOS technology.

Point-of-care test (POCT) systems have shown great promise as diagnostic techniques that provide fast, convenient results at or near the site of patient care. These methods, which are widely used, often involve labeling techniques that employ fluorescent, chemiluminescent, redox, or radioactive probes, etc. Although such methods provide high sensitivity, they are complicated because their labeling steps require a significant amount of time and labor in their execution and in the analysis of their results. As an alternative, label-free electrical detection by employment of a CMOS transistor, which works by monitoring changes in their intrinsic electrical properties, has attracted a great deal of attention. Miniaturization as well as the integration of sensors and readout circuitry has been enabled by industrialized microfabrication technology. If the sensors and circuitry are monolithically integrated on the same substrate, then the fabrication cost can be remarkably reduced. Hence transistor based biosensors are briefly reviewed, and each advantage and disadvantage are compared. Recent progresses by use of standard CMOS processes are presented and discussed. The discussions will also address the structural modifications of MOSFET based biosensors, different options for sensing metrics, and the effects of environmental conditions in this technology [1]-[4]. Finally, it is concluded that a CMOS based biosensor can pave a new way in applications of matured CMOS technology for a field of biotechnology.

[1] H. Im, et al., "A dielectric-modulated field-effect transistor for biosensing", Nature Nanotechnology, vol. 2, pp.430-434, 2007.

[2] J.-H. Ahn, et al., "Double-gate nanowire field effect transistor for a biosensor", Nano Letters, vol. 10, pp. 2934-2938, 2010.

[3] C.-H. Kim, et al., "CRP detection from serum for chip-based point-of-care testing system", Biosensors and Bioelectronics, vol. 41, pp. 322-327, 2013.

[4] K. Choi, et al., "Integration of field effect transistor-based biosensors with a digital microfluidic device for a lab-on-a-chip application", Lab on a Chip, vol. 12, pp. 1533-1539, 2012.

15:00

BioVLAB: A bioinformatics system infrastructure based on cloud computing and graphical workflow composers

***Sun Kim*[1], *Heejoon Chae*[2]**

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The cloud computing is shaping a new computing paradigm and it is being utilized for applications in life sciences. In this talk, we will introduce BioVLAB, a bioinformatics system infrastructure that combines both cloud computing and a graphical workflow composer in a 3-tier architecture. The first part of this talk will introduce BioVLAB. The second part of this talk will share our experience of deploying BioVLAB for cancer research. The recent advance in sequencing technologies, known as the next or 3rd generation sequencing technologies, made it possible to measure genetic and epigenetic data on the whole genome scale. This opportunity comes with challenges for processing and computational analysis of the genomic and epigenomic data. Specifically, analyzing such data requires the involvement of experts in bioinformatics and computer science as well as a good computing infrastructure. Resolving these two issues (computing infrastructure and bioinformatics expertise) will broaden the scientific research community that utilizes the genome-wide data and will allow participation of small research labs. To achieve these goals, use of the cloud computing addresses the need for computing infrastructure for small research labs and use of the graphical workflow composer addresses need for bioinformatics expertise. Thus, end users can perform the bioinformatics computational analysis using BioVLAB in three simple steps by downloading a pre-composed workflow, creating an account on the Amazon EC2 cloud, and then running the workflow. We will present two systems using the infrastructure: BioVLAB-MMIA for the integrated analysis of microRNA and mRNA and BioVLAB-mCpG for the integrated analysis of DNA methyaltion, SNP, and gene expression data.

16:00

Introduction to Samsung Advanced Institute of Technology - Bringing nano-science into engineering

Sungwoo Hwang

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Samsung Advanced Institute of Technology (SAIT) was founded in 1987 as a central R&D hub of Samsung group, and has been actively performing top-tier research topics. Its research area covers a broad range of future business items including information technology, advanced devices, new materials, and bio/medical technology. The first half of the talk will be the overall introduction of SAIT, and the last half will be devoted to our recent efforts of pushing nano-science into engineering. Full color quantum dot displays [1, 2], GaN light-emitting diodes on glass [3], and graphene barristor devices [4] are the examples to be discussed.

[1] Nature Photonics **3**, 341 (2009).

[2] Nature Photonics **5**, 176 (2011).

[3] Nature Photonics **5**, 763 (2011).

[4] Science **336**, 1140 (2012).

16:30

The Internet of Things - from an academic dream to commercial reality

Friedemann Mattern

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The term “Internet of Things” has come to describe a number of technologies that enable the Internet to reach out into the real world of physical objects [1]. It connects digitally augmented objects to global cloud services, and it allows appliances, products, and other mundane things to cooperate among each other and even to interact with us.

A world full of smart things would give rise to many fascinating applications and new business opportunities. There are still a number of challenges, however, that must be addressed before the Internet of Things can become a commercial reality beyond prototypes. These challenges are not only purely technological – issues such as appropriate application-level communication protocols or generic principles for the interaction of smart things with humans, for example, are equally important

In our talk we will first summarize the expectations and opportunities of an Internet of Things. We will then discuss some challenges and present our suggested solutions to overcome the hurdles. We will also present several applications and prototypes of cooperating real-world objects that have been realized in our research group together with supporting software platforms to connect digitally augmented things to the Internet and the whole WWW ecosystem.

[1] Friedemann Mattern, Christian Floerkemeier: From the Internet of Computers to the Internet of Things. In: Kai Sachs, Ilia Petrov, Pablo Guerrero (Eds.): From Active Data Management to Event-Based Systems and More. LNCS, Vol. 6462, Springer, pp. 242-259, 2010

17:00

Cloud services in the mobile computing era

Songkuk Kim

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Cloud computing has changed how computing services are provided. A big scale of parallel processing can produce new services like machine translations and video search. Also, cloud networking proved that on-demand video could be streamed around the world for mass public.

Mobile devices have transformed the way people consume information and contents. People use smart phones longer than the desktop computers. Also, mobile devices made people feel computing services more intimate and friendly.

Cloud services and mobile devices have evolved in the mutually beneficial relationship. A Large portion of smartphone apps are backed by servers in cloud computing facility. Cloud computing has gotten more attention due to the wide spread of mobile devices with computing power smaller than the personal computers.

Cloud computing has altered not only how the services are generated but also how it is delivered. It changed even the topology of the Internet. At the same time, mobile network has grown into major landscape of the Internet.

In this talk, we will discuss how two technologies have evolved symbiotically. Also, we will present technical breakthroughs and challenges in cloud computing, which could be applied into the mobile services.

Wednesday, May 8, 2013

09:15

On the Design of a Smart Sensor Project

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This talk explains the motivation, challenges, and expected outcomes of a smart sensor design project started in late 2011 with a funding from Korean government via. 'Global Frontier Project' system, which calls for both ground breaker (innovation) AND contribution to industrial growth (sustenance). I like to mention how we tried to meet these goals by optimal project design in three layers, i.e., core technology, platform design, and sensor development, such that platform and sensor layers support each other in an efficient way, while essential core technologies are included as frontier guards for ground breaking.

Sensors are classified into four major application areas according to specific requirement on four major components of the design objective, i.e., distortion, rate, energy usage, and total cost. Generic smart sensor has three main paths; energy path, signal path, and control path. Signal path comprises mainly digital and analog processing parts, stacked and by-located memory system, and RF and optical communication parts. Energy path consists of power transfer part and energy harvester, while control path is implemented as a dynamic ERD (energy-rate-distortion) optimizer which consists of various status (battery, memory, channel, etc.) monitors and event detector.

The role and anatomy of each of the three layers will be described, followed by brief introduction to a few sensors being developed in the CISS (Center for Integrated Smart Sensors) along with how the sensor development task is supported by the platform layer players. Finally, we will also mention on the possible direction of smart sensor design with a notion of ultimate cost function.

10:15

Nanosystems: technology, devices, circuits and applications

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Nanosystems are large-scale integrated systems exploiting nanoelectronic devices. In particular, this talk considers double independent gate, vertically-stacked nanowire FETs with gate-all-around structures and typical diameter of 20-nm. These devices, which we have successfully fabricated and evaluated, control the ambipolar behavior of the nanostructure by selectively enabling one type of carriers. These transistors work as switches with electrically-programmable polarity and thus realize an exclusive or operation. The intrinsic higher expressive power of these FETs, as compared to standard CMOS, enables us to realize more efficient library cells, which we organize as tiles to realize circuits by regular arrays. This article surveys both the technology for double independent gate FETs as well as physical and logic design tools to realize digital systems with this fabrication technology.

11:15

Using STT-RAM for Low-Power Cache

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Spin-Transfer Torque RAM (STT-RAM), which is a kind of non-volatile magnetoresistive memory, is getting more and more attention these days due to its excellent characteristics. In particular, there are attempts to use it for on-chip caches since it is fast enough, scalable, and easily integrated into a CMOS chip. This talk presents several approaches to using STT-RAM for low-power on-chip cache.

First apporach is to reduce static power consumption in peripheral circuits of STT-RAM when it is used as an instruction cache. It is based on the observation that only a small number of instructions is accessed inside a program loop. We propose to add a small SRAM cache called loop cache between the processor and the L1 instruction cache made of STT-RAM. When executing a loop, if the entire loop gets cached into the loop cache, then the L1 instruction cache can be turned off to save energy during the execution of the loop.

A drawback of STT-RAM is its high write energy, which increases dynamic power consumption. This talk presents a technique called lower-bits cache, which can be used for reducing write activities of STT-RAM L2 caches. Based on the observation that upper bits of data are not changed frequently compared to lower bits in most applications, the technique tries to hide frequent bit changes in lower bits from the L2 cache.

Recent researches revealed that device scaling makes write operations of STT-RAM unreliable due to lower write voltage required to prevent breakdown of small cells. This talk also presents a low-cost, ECC-based solution to mitigate the impact of such a problem. It is based on the observation that STT-RAM bit errors occur only at the time of write operations, while most of the write operations are successful. Thus, the approach tries to share storages for ECC among different blocks within a set and use them only for unsuccessful write operations.

[1] Junwhan Ahn and Kiyoung Choi, "Lower-bits cache for low power STT-RAM caches," *IEEE International Symposium on Circuits and Systems*, pp.480-483, May. 2012.

[2] Junwhan Ahn, Sungjoo Yoo, and Kiyoung Choi, "Selectively protecting error-correcting code for area-efficient and reliable STT-RAM caches," *Asia and South Pacific Design Automation Conference*, pp.285-290, Jan. 2013.

11:45

Perspectives and challenges of biosensor integration

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Integrating biosensors and signal processing circuits would enable a new generation of biochips, providing addressing, measurement and elaboration functions on the same system. Potential applications for such multi-functional systems range from genetic arrays to personalized medicine-based tests, to cells manipulation and sensing. Nevertheless, a suitable interface between CMOS and the physiological solution or wet environment is required in the form of novel high-tech packages that would (i) allow to dispose the sensing surfaces, (ii) prevent circuit damages, (iii) protect cells or maintain stability of biological reaction from temperature changes due to the circuit heat generation. We propose a viable solution to these issues, paving the way to the widespread use of low-cost semi-disposable biochips. The development of disposable top sensing layer would allow to keep the silicon chip with storage and signal measurement and processing, and to configure the system for different applications.

[1] Y. Temiz, A. Ferretti, Y. Leblebici, C. Guiducci, “A Comparative Study on Fabrication Techniques for On-Chip Micro- electrodes”, Lab Chip, 2012, 12, 4920–4928

[2] Y. Temiz, C. Guiducci, Y. Leblebici, “Post-CMOS Processing and 3D Integration Based on Dry-Film Lithography”, Transactions on Components, Packaging and Manufacturing Technology, Components, Packaging and Manufacturing Technology, IEEE Transactions on , vol.PP, no.99, pp.1, 0

[3] Y. Temiz, S. Kilchenmann, Y. Leblebici, C. Guiducci, "3D integration technology for lab-on-a-chip applications," Electronics Letters, vol.47, no.26, pp.S22-S24, 2011

[4] C. Guiducci, Y. Temiz, Y. Leblebici, E. Accastelli, A. Ferretti, G. Cappi, E. Bianchi, "Integrating Bio-sensing Functions on CMOS Chips," Proc. of Asia Pacific Conference on Circuits and Systems (APCCAS), 2010.

12:15

R&D activities on emerging materials and devices at LG Electronics

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In this presentation, research and development activities at Materials and Components (M&C) laboratory in LG Electronics (LGE) will be overviewed. M&C laboratory is a central R&D organization of LGE that is dedicated to establishing emerging science and technology foundation for the company's future. In order to effectively facilitate this mission, we collaborate with numerous research institutions worldwide to share knowledge and ideas to secure core technologies as well as pioneer science and technology fields. Presently, our main areas of focus are in area of Living & Eco, Healthcare, Energy and Materials & Devices. In particular, LGE has identified novel materials and devices as a key area that will increasingly determine the competitiveness of future IT products such as home applicances and mobile systems.

Material technology at M&C laboratory mainly deals with synethesis of nanomaterials for applications in next generation displays, water treatment and novel functional devices. Graphene, quantum dots and new magnetic composites are some of the examples on nanomaterial research activites. Device technology covers fundamental research relevant to optoelectronics, energy harvestors and sensors. Topics in optoelectronics range from high efficiency polar/nonpolar light emitters to Si/compound semiconductor based solar cells, while energy harvestors include thermal and kinetic energy conversion devices. Optoelectronic and energy harvestors minimizes energy loss and/or recycle unused ambient energies and they reflect LGE's committement to enviornmental friendly solutions for increasing resource challenges and environmental threats. In the area of sensors, development of technologies for bio signal, microorganism and gas detection are being pursued, while other innovative devices based on covergence with nanomaterial and MEMS technologies are also under active investigation.

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