

# Swiss Research Program Nano-Tera .ch

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

## Activity Report 2014

## NANO-TERA.CH: FUNDING RESEARCH IN SYSTEMS ENGINEERING



Prof. Giovanni De Micheli  
Nano-Tera.ch Program Leader,  
Executive Committee Chair

Nano-Tera.ch is a national funding program supporting research in engineering of complex (tera-scale) systems for health and the environment using nanotechnologies.

Energy and security issues are also investigated as crucial transversal themes in system design. Nano-Tera.ch research funding is open to all Swiss institutions according to the corresponding legislation. Moreover, Nano-Tera.ch fosters collaboration among researchers and industries that are partners or supporters of the research projects.

The Swiss National Science Foundation (SNSF) contributes to the Nano-Tera.ch program by evaluating and monitoring the large research projects through an international panel of experts, thus ensuring the high scientific quality of the program.

The mission of Nano-Tera.ch includes research, development and technology transfer as well as education and dissemination. The final objective is to enable mechanisms that can map the high productivity of research ideas, publications and patents of the Swiss community into a significant momentum in terms of industrial growth as well as job and enterprise creation. This specific engineering focus differentiates Nano-Tera.ch from other funding programs.

## NANO-TERA.CH: SWISS EXCELLENCE IN RESEARCH



Prof. Heinrich Meyr  
Nano-Tera.ch  
Scientific Advisory Board Chair

The Scientific Advisory Board reviews the Nano-Tera.ch program as a whole and provides criticisms and suggestions for its future growth. The Board regards the Nano-Tera.ch program as a unique blend of technology exploration and system design. The scientific and industrial challenges studied in the program are related to exploiting micro and nano components within complex systems whose added value is much larger than the sum of their parts. A notable example is networked sensors for medical and environmental applications. Networking 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.

Smart and diversified energy generation, such as harvesting and low-power system design are of the utmost importance to society and the economy. Truly innovative approaches are needed, that can only be found by massively investing in engineering research. Thus the Board lauds the extension of the Nano-Tera.ch scope to include energy as an application area.

The upcoming scientific and engineering challenges are too heterogeneous and complex to be solved within a single scientific domain. They require a truly collaborative and crossdisciplinary approach. The Nano-Tera.ch program brings together excellent researchers in various fields from many Swiss institutions with outstanding reputation.

The program is not only of high scientific value but also of eminent economic importance for the industrial sector of Switzerland. The program serves as the seed for truly innovative products and industries. It also fosters the education of highly-qualified engineers and researchers who are the most valuable and indispensable resource of this country.



“Nano-Tera.ch has provided new and important research opportunities as an instrument for application oriented collaboration in engineering that did not exist before, and that foster very challenging systems engineering projects. The projects demonstrate that collaboration of leading scientists is effective and essential to break new grounds for large technical and societal challenges. It forces scientists to think about how to integrate their scientific findings in such a manner that it can be used for industrial applications. The program has supported the shift in the mindset from individualistic towards multidisciplinary and cross-disciplinary research.”

#### The SNF Evaluation Panel

“The presence of numerous prototypes and demonstrators was considered as a tangible sign that the program truly managed to focus on concrete collaborative research leading to potentially exploitable results. The increased presence in the phase 2 RTD projects of teams coming from University hospitals clearly illustrates the strong involvement of medical end-users, able to carry out valuable clinical trials for the evaluation of the results generated by these projects in health related domains.”

#### The Nano-Tera.ch Scientific Advisory Board

Nano-Tera.ch is a Swiss national program supporting research in multi-scale system engineering for health, security, energy and the environment. The broad objectives of the program are to improve quality of life and security of people and to create innovative products, technologies and manufacturing methods, thus impacting job and revenue creation.

Launched officially in February 2008, Nano-Tera.ch is a strongly established program which concluded its first phase in 2013 (with 77 research projects carried between 2009 and 2013 for a total budget of about 123 MCHF), producing about 740 publications and almost 1300 presentations at conferences and workshops worldwide. The research led to numerous concrete demonstrators and prototypes, a tangible sign that the program truly managed to focus on concrete collaborative research leading to potentially exploitable results.

Building upon this success, Nano-Tera started its second phase (2013-2016), with projects now well under way. There are currently 25 RTD projects running for a period of 3 or 4 years. The program is keeping its topical focus on health and the environment and takes advantage of its momentum to pursue its main objectives: excellence in collaborative research in engineering disciplines, educational programs, design of applied demonstrators, and transfer of acquired research results to the Swiss industry. What is new is the arrival of research topics combining engineering with life sciences, medicine and energy. In addition to RTD projects, 9 NTF projects have been selected by an international panel of experts and started in November 2013 for a duration of 2 years.

From an industrial perspective, most of the running RTD projects receive support from industrial partners and hospital end-users: in total, 34 industrial partners are involved in the Nano-Tera.ch RTD projects, for a total of 3.1 million CHF of in-cash and in-kind contributions and 15 hospital partners are contributing 5.2 million CHF to the projects. Furthermore, 8 patent applications have already been filed so far in the new projects.

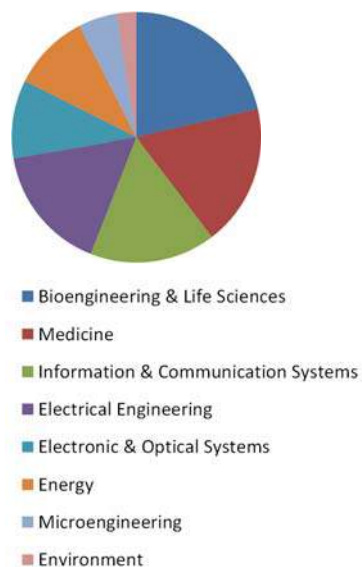
The Nano-Tera website ([www.nano-tera.ch](http://www.nano-tera.ch)) represents one of the main dissemination channels for the program: during the current reporting period, it has received over 100,000 page views from more than 140 countries.

## INTRODUCTION

Partner distribution by institution



Partner distribution by discipline



The objective of the Nano-Tera.ch program is to support research, design and engineering of complex systems and networks using micro/nano-technologies. More precisely, the program aims at identifying and fostering potential synergies between micro/nano component technology (the “nano” part) and large-scale system design (the “tera” part) to meet the growing need for complex engineered solutions to socially relevant issues related to Health, Security, Environment, and Energy. Examples of such issues are detecting in real time different health risks and conditions through integrated bio probing, revealing security risks through smart buildings and environments, continuous ambient sensing through low/zero-power electronics, or detecting and monitoring environmental hazards such as floods or avalanches. Embodiments of such solutions will typically take the form of lightweight, mobile and personalized products embedded in the environment and on/in the human body.

To meet these objectives, Nano-Tera.ch supports three types of projects:

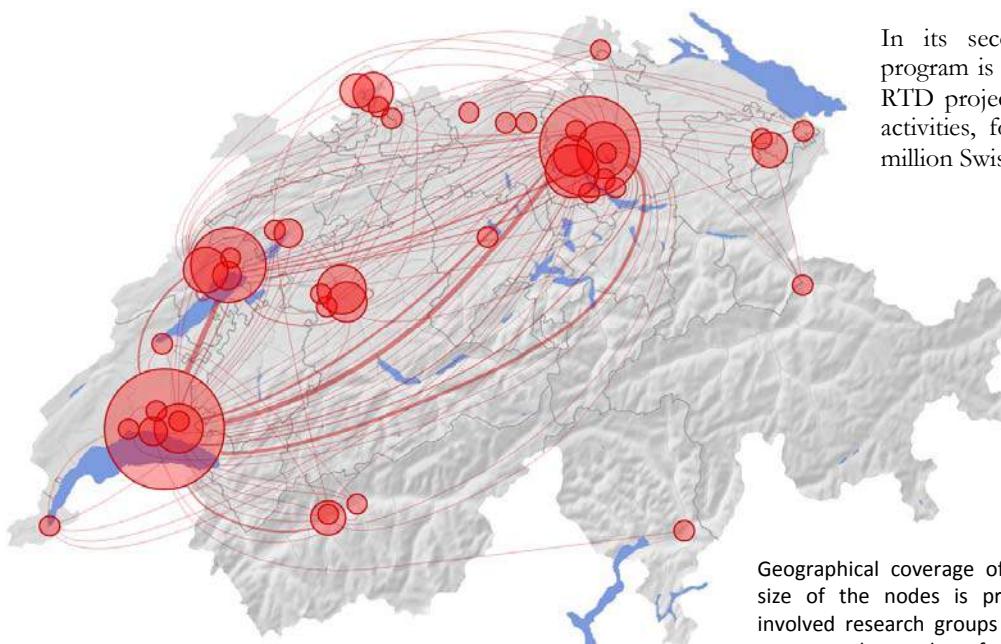
**Research, Technology and Development (RTD)** projects, representing about 80% of the Nano-Tera.ch activities, are large integrated, interdisciplinary research projects involving a collaboration between two (or more) research groups, preferably from different institutions. RTD projects typically focus either on the in-depth study of a particular vertical technology or on the development and implementation of a horizontal application area. The expected duration of RTD projects is 3 or 4 years, with total budgets in the range of 1-2 MCHF/year.

**Nano-Tera Focused (NTF)** projects are small-scale research projects addressing specific scientific/technical issues and needs. Their typical duration ranges from one to two years, with total funding of around 100-200 kCHF.

**Education and Dissemination (ED)** activities correspond to actions aiming at supporting short courses, workshops, mini-conferences, and developing new curricula in domains covered by Nano-Tera.ch that are not provided by Swiss Universities or Polytechnics. ED activities may address the in-depth study of a technology or interdisciplinary horizontal activities, and their typical funding level is in the range of 15-30 kCHF.

The Nano-Tera.ch program is funded by the Swiss Polytechnic and University Boards (ETH Board and CUS), under the supervision of the Swiss Secretary of Education and Research (SER). The Swiss National Science Foundation (SNSF) evaluates and monitors Nano-Tera.ch research projects through an international panel of experts.

### OVERALL RESULTS, PHASE II (2013-2016)



In its second phase, the Nano-Tera.ch program is funding 46 research projects: 25 RTD projects, 9 NTF projects and 12 ED activities, for a total budget of about 132 million Swiss francs.

These projects are carried out by consortia of 3 to 10 research groups, building a network of 37 Swiss research institutions, involving more than 600 staff members. As illustrated by the map, this network represents a very dense geographical coverage of Swiss research institutions.

Geographical coverage of the Nano-Tera program. The size of the nodes is proportional to the number of involved research groups and the thickness of the links measures the number of collaborations.

## SCIENTIFIC DISSEMINATION

### Publications

In terms of scientific dissemination, the funded research has generated about **120 publications** in this new phase of Nano-Tera.ch. The distribution of the publications by publication type (journals or conference proceedings) is given below.

Journal and book publications	29
Conference proceedings	91
Total	120

### Conferences and workshops

More than **200 presentations** at conferences and workshops have been given (half of which were invited oral presentations, the other half were other oral presentations or posters), and the projects have led to several presentations in the media (television, radio, press).

### Awards

So far, **6 awards** have been received by Nano-Tera researchers, for best presentations, thesis or paper.

### Collaboration with the industry and patents

Most RTD projects receive support from various industrial partners and hospital end-users. In total, **34** industrial partners are involved in the Nano-Tera.ch RTD projects, for a total of 3.1 million CHF of in-cash and in-kind contributions and **15** hospital partners are contributing 5.2 million CHF to the projects.

	Industrial partners	Hospital end-users
Number of partners	34	15
Number of projects with partners (of 25)	18	10
Contributions (MCHF)	3.1	5.2

Furthermore, **8 patent applications** have been filed for results related to the Nano-Tera.ch projects.

## MAIN SCIENTIFIC ACHIEVEMENTS

Nano-Tera.ch supports 25 collaborative 3- and 4-year 'RTD' projects, uniting teams right across the country. The theme of health features strongly among the research subjects selected, with strong participation from university hospitals and doctors. The themes of environmental monitoring and energy are also taking pride of place.

With an average budget of about CHF 5 million, they are funded at 45% by Nano-Tera.ch, the rest of the budget being provided by the participating institutions.

As with previous calls for proposals, the key domains of Nano-Tera.ch (Bioengineering and Electronics) are well represented in this selection. What is new compared to the earlier phase of the program is the arrival of research topics combining engineering with life sciences, medicine and energy.

### A STRONG FOCUS ON HEALTH APPLICATIONS

The university hospitals and the specialists that thrive there, such as specialized surgeons, neurologists and cardiologists, represent about a fifth of all co-investigators involved. The CHUV, the InselSpital of Bern, the University Children's Hospital in Zurich, the University Hospitals of Basel and Zurich and the Hospitals of Schaffhausen are all bringing their knowledge and expertise to the research of the Nano-Tera program. Research with health-related applications can be loosely arranged in three distinct thematic clusters:

#### SMART PROSTHETICS AND BODY REPAIR

Smart prosthetics and body repair is an integral part of the program, with projects addressing tactile prosthetics and other sensorimotor functions (in particular after spinal cord injury), smart muscles for incontinence treatment or micro surgery. More specifically, the following challenges are being addressed:

**Image-guided micro surgery for hearing aid implantation.** The project **HearRestore** is developing novel robotic technologies to drastically reduce the invasiveness and improve the outcome of cochlear implant surgery. The project specifically aims to increase the safety of the procedure through the implementation of advanced surgical planning/image analysis, non-invasive registration, modeling/prediction of bone drilling, neuromonitoring, and nanometer tracking. A recent highlight is the successful transfer of the base technology to clinical use. The project was able to achieve regulatory clearance from both the local institutional review board – ethics commission – and the regulatory body Swissmedic for a first clinical trial. Additionally, a live animal study was launched in collaboration with all four partner institutions, which will help evaluate a new nerve stimulation probe to improve the accuracy of facial nerve detection.



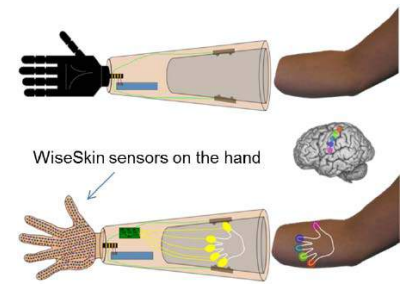
**High-performance spinal cord neuroprosthesis for restoration of locomotion after spinal cord injury.** The mission of the **SpineRepair** project is to develop and optimize the enabling technologies to implement a cutting-edge spinal cord neuroprosthesis, allowing victims of paraplegia to recover partial mobility. Prototypes of the novel integrated devices are evaluated in animal models. The findings pave the way towards fundamentally new technological solutions and treatment paradigms to improve functional recovery in severely paralyzed individuals in a timely manner. So far, the research team has demonstrated a chronic, wired, soft spinal cord neuroprosthesis for a rat model, developed novel stretchable wiring based on Ag nanowires, defined the layout of the implantable electronic hardware and the CMOS stimulator, and conducted the first characterization of locomotion enabled by the multielectrode array implants in spinal rats.

**Use of superparamagnetic nanoparticles for the detection and treatment of cancer.** Indeed, such particles are used as contrast agent for MRI, especially for the liver, and as heat sources for the treatment of tumors (magnetic hyperthermia). The goal of the project **MagnetoTheranostics** is to combine both application using optimized particles for imaging and heating in an alternate magnetic field. So far, the consortium has developed a synthesis method to manufacture superparamagnetic iron oxide nanoparticles; the animal model was selected and the team is building the magnetic field generator.

**Cutting-edge technology for the next-generation of artificial muscles.** The application being targeted in **SmartSphincter** is smart muscles for incontinence treatment and involves hundreds of thousands of low-voltage, dielectric,

electrically activated nanometer-thick polymer layers. Already, the researchers have found two promising alternatives to conventional stiff metal electrodes for the polymer actuators and shown that they are able to power them for 10 days without recharge from available lithium ion cells. The team has also successfully applied to their local ethical committee for a full pilot study involving 10 male and 10 female participants.

**Wise skin for tactile prosthetics.** Amputation of a hand or limb is a catastrophic event resulting in significant disability with major consequences for daily activities and quality of life. A sense of tactility is needed for providing feedback for control of prosthetic limbs and to perceive the prosthesis as a real part of the body, inducing a sense of “body ownership” and a natural sensation of touch. The idea of the **WiseSkin** project is to provide a non-invasive solution for restoration of a natural sensation of touch by embedding miniature tactility sensors into the cosmetic silicone coating of prostheses, which acts like a sensory “skin”. Already, a first sample of the artificial skin was developed.



## HEALTH MONITORING

Nano-Tera focuses on personalized health management through the use of implanted devices, smart textiles and intelligent drug monitoring systems. Application targets are in the fields of monitoring of obesity and neonatology, among others.

Like in the initial phase of Nano-Tera, the area of health monitoring and personalized health management is well covered, with several projects addressing different research avenues, such as:



**Monitoring the consequences of obesity.** **ObeSense** is building integrated wearable body sensors networks to monitor obese patients at different stages of the disease. The physiological sensors include respiratory rate and volume, energy expenditure, blood pressure and cardiac output and are to be integrated into stand-alone comfortable systems using both low power electronics and smart textiles. Regarding the monitoring of the respiratory rate and volume, transparent flexible polymer-optical fibers have already been integrated in a smart T-shirt and have been successfully tested. Moreover, near infrared spectroscopy is being developed to measure the arterial and venous oxygen saturation, important parameters to determine energy expenditure. An application

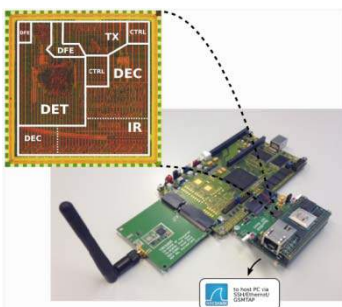
for mobile phones and tablets has been developed.

**Monitoring of the healing of chronic wounds.** The research consortium of **FlusiTex** is fabricating a sensing wound pad that can be used for non-invasive wound monitoring based on integrated fluorescence coupled biosensors, and which is likely to find broad applications in strongly growing fields such as health care and medtech.

**Newborn monitoring based on multiple vision sensors.** The increasing number of parameters to monitor and the sensitivity of current sensors to body movement are responsible for unacceptably high rates of false alarms in new born monitoring. **NewbornCare** seeks to drastically reduce the false positive alarms by using a computer vision-based approach to estimate accurately the heart and respiratory rates in a contactless fashion.



**Therapeutic drug monitoring for personalized medicine.** The overall benefit of this research is to develop a technological platform to improve medical practice by enabling personalized medicine via therapeutic drug monitoring, while reducing healthcare costs. This **ISyPeM II** project is exploring new sensor technologies, hardware and software data processing means, and drug release mechanisms based on silicon membranes. This will provide a comprehensive integrated approach to Therapeutic Drug Monitoring which combines innovative point-of-care compatible assays, prescription decision support and interoperability in a complex data-sharing scenario.



**A system on a chip to make medical devices wearable.** For both in- and outpatient applications, the electronic interface to typical sensors and electrodes still has a size and weight that prevents it from being used in the convenient and flexible way. Integration of the plethora of functionalities required in a wearable medical monitor, including the management of wireless connectivity, holds the key to the breakthrough required for clinical and user acceptance. This is why **WearMeSoC** is developing a chip that will enable very small wearable medical monitors with wireless connectivity to small phones and tablets. So far, the prototype of hardware platform is ready and has been evaluated by medical partners, the design of the SoC started and progresses well.

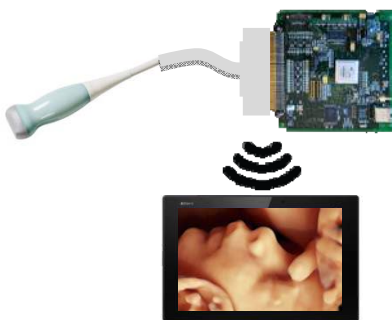
## MEDICAL PLATFORMS

In this new phase, Nano-Tera.ch is developing several medical platforms, notably a next-generation, high-quality, mobile ultrasound imaging device and elastic, lightweight MRI detectors that patients can wear like a piece of clothing. The research covers several fields of medicine, such as oncology.

**Wearable ICT for zero power medical applications.** Keep your friends close, but keep your medical sensors closer: such could be the motto of the **BodyPoweredSenSE** project, which aims to demonstrate that smart medical diagnostics can be performed using ergonomic, efficient, energy harvesting based sensors. Specifically, the scientists are developing smart, energy aware, user friendly wearable sensors and associated medical algorithms for the early diagnosis of Alzheimer's disease and childhood epilepsy, where the sensors derive power from the user's body energy (heat and motion) as well as from ambient light. The energy harvesting work has resulted in several prototypes being tested in the laboratory. Thermoelectric generators have been integrated into headwear and the stretching piezo composite materials are being evaluated. Design of the embedded clinical applications for ECG and EEG has begun as well as the design of a test hardware platform so that real time energy consumption can be evaluated. At the clinical level, the set of epilepsy detection algorithms are being finalized and EEG algorithms are being tested. Finally, the team is working on system level networks and potential means to save energy through collaborative system behaviors.

**Novel semiconductor disk lasers for biomedical and metrology applications.** In a follow-up to the original MIXSEL project, **MIXSEL II** is consolidating its high-power ultrafast semiconductor laser technology. The goal is to develop prototype demonstrators for end-user demonstration in biomedical imaging, compact efficient white light generation for general high brightness illumination and frequency metrology applications. So far, the project has achieved the first demonstration of a femtosecond MIXSEL generating 620 fs pulses at 4.8 GHz repetition rate and 101 mW average output power.

**Rapid sensing of cancer.** **PATLiSci II** is developing rapid diagnostic tools for cancer by paralleled mechanical cantilever sensors to investigate the elastic properties of biopsy samples in a fast and reliable way. Such a cantilever array approach reduces diagnosis times from 3 hours to minutes, allowing faster decision on the appropriate therapy. Rapid biomarker tests based on cantilever sensors complement information on the status of the tumor. The project is benefitting from its predecessor, where basic concepts of parallel force spectroscopy and nanomechanical biomarker sensing were validated. The approach here is to combine two complementary methods (force spectroscopy mapping for cell stiffness and nanomechanical cantilever sensing for biomarker detection) into a single instrumental platform, which can be handled easily. First conclusive results on discrimination of breast cancer cells from unaffected cells in tissue using a single cantilever have already been demonstrated. Investigation of RNA in melanoma and wild type cells shows clear difference in nanomechanical bending response of functionalized cantilevers, in particular the BRAF mutation which is essential for selection of appropriate treatment measures.



**High performance portable 3D ultrasound platform.** While ultrasound imaging is ubiquitous in medicine due to its low cost compared to other imaging techniques such as MRI – whose own challenges are addressed below – its image quality is usually poorer, and the high-quality devices that exist are expensive and aimed at hospital operation only. This is the reason why **UltraSoundToGo** is developing a prototype of next-generation, high-quality, mobile ultrasound imaging device, while operating at a level of power consumption compatible with battery-powered operation on the field. So far, an early version of compressive sensing applied to ultrasonic imaging was developed, as well as a novel image reconstruction technique that reduces pressure on the hardware memory interface. Regarding software implementation, a QoS-aware flow and a parallel beamforming algorithm were prototyped.

**Wearable MRI detector and sensor arrays.** Magnetic resonance imaging (MRI) is another widely used imaging technique in medical diagnostics and basic research. The project **WearableMRI** seeks to advance the technique by introducing flexible, lightweight signal detectors that patients can wear like a piece of clothing. What renders this project unique in this field is the radical step from rigid, cage-like detectors to wearable assemblies that conform to the patient. To master this transition, the project is tackling unique challenges of mechanical and electronic adaptability along with those of miniaturization. At this point, the system design for a demonstrator has been completed. The evaluation platform is essentially completed and has already been demonstrated in practice, receiving high-fidelity MR signals from conventional detectors with non-integrated in-magnet digitization and optical transmission.

## A NEW LOOK AT ENVIRONMENTAL MONITORING WITH FURTHER CHALLENGES

Given the importance of environmental monitoring, several projects from Nano-Tera's initial phase are extended into the second phase with new directions. Projects address both air and water pollution monitoring, as well as environmental sensing in mountainous areas, as detailed below:

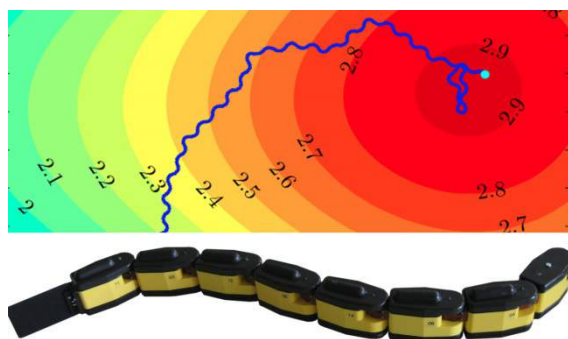
**Crowdsourcing high-resolution air quality sensing.** A major issue for obtaining accurate and high-resolution air pollution maps is the tradeoff between the cost of the measurement device and its accuracy. To address this problem, the **OpenSense II** consortium is integrating all available data sources starting from the infrastructure developed in the original OpenSense project, together with the high-end static stations of the National Air Pollution Monitoring Network and crowd-sourced data. In addition, the team is studying the impact of exposure to air pollution on human health and evaluating the potential of crowdsourcing for providing feedback to users. This involvement of private citizens as both providers of data and users of health recommendations is a novel contribution and will effectively close the loop between data gathering and the end-user.

### **MEMS acoustic detectors for natural hazard warning systems.**

Understanding, controlling and minimizing the risk associated with changes in our natural environment is of major societal interest, and there is an increasing need for risk-reduction methods and technology. The alpine monitoring system developed in X-Sense is extended with its **X-Sense II** to contribute to the reduction of this growing gap by technological development and scientific advance. It is investigating a complete data chain from custom designed sensor technology over networking, data-based storage and processing towards new discoveries in environmental sciences and new, more effective technologies for early warning.



**An all-in-one detection platform for air pollutants and greenhouse gases.** The environmental dimension can also be a new direction added to a past project. While IrSens developed a sensing platform for liquid and gases using near and mid-infrared spectroscopy to measure cocaine concentration in saliva and CO<sub>2</sub> isotope ratios in air, **IrSens II** is going several steps further by realizing new tools for gas monitoring, specifically analyzing nitrogen dioxide as well as major air pollutants and greenhouse gases. The main difference between this project and others in the field is the use of multi-color distributed feedback lasers, with which several wavelength sources coming out of the same laser can be obtained. This considerably decreases the complexity of the optical setup of the sensor.



### **An aquatic robot which can “smell” polluting substances in water.**

A completely new environment-related project is **Envirobot**, which is developing an anguilliform robot equipped with physical, chemical and biological sensors to automatically survey surface water quality. Currently, environmental contamination is routinely measured by sampling at defined locations and time intervals with subsequent off-site analysis of the collected sample, but rarely in a continuous manner along a trajectory by a moving vehicle or vessel. Not only will the aquatic robot sample, measure and communicate water quality parameters autonomously, but the robotic system will ultimately be able to guide its movement along a pollution gradient

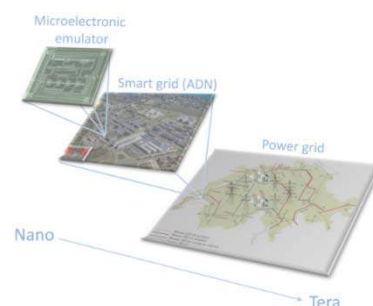
towards the pollution source. So far, data communication between the robot modules and sensors has been established and the first physico-chemical sensors have been tested and implemented in individual modules. Robot swimming has been improved and algorithms have been developed to allow source tracking. In addition, important progress has been made with biological sensor elements. A method for automated heart-beat tracking has been developed on single *Daphnia* individuals captured in microfluidic cages, that can be used to monitor distress upon pollutant exposure.

## A CRUCIAL MATTER: THE MANAGEMENT OF ENERGY

The theme of energy has taken on a whole new dimension in this phase of Nano-Tera.ch. In the past, the research being funded related mostly to ultra-low power microchip or systems. As energy is a central theme that affects system design, society and the economy, it now takes center stage. In this domain, Nano-Tera.ch addresses various high relevance application areas such as low-power trustable electronics, smart grids, green data centers and environmentally friendly energy harvesting systems:

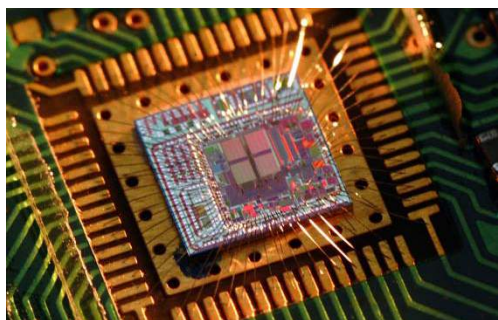
**Cost-effective and integrated solar-hydrogen generator.** The development of economically viable technologies to produce fuels such as hydrogen, solely based on sunlight and water is one of many potential solutions, on a global scale, to transition from a fossil fuel economy to a renewable energy economy. **SHINE**'s goal is to develop the design principles and experimentally demonstrate a continuously-operating solar-hydrogen generation system with an optimal working point in terms of fuel production cost. In the first year of the project, SHINE has developed the foundations to achieve viable solar-hydrogen generations.

**Real time monitoring and management of smart grids.** The project **SmartGrid** seeks to optimize the power grid through a hierarchical vision, from the individually monitored power consumption of electrical appliances, across the mid-scale “Microgrid” that optimizes small pools of consumers and at high level with high speed electronics for power system dynamic emulation. The team is developing new technologies dedicated to the real-time monitoring and secure management of electricity distribution using specific microelectronics ICs and real time ICT. The architecture of the smart building management platform has been designed and tested. The team is using the EPFL campus for validation: already, a preliminary version of the EPFL active distribution network process is successfully running.



**Green servers and datacenters.** Energy-efficient datacenters are of strategic importance to Switzerland, as 75% of the Swiss economy is service-based and depends on the IT datacenter infrastructure cost. In **YINS**, the researchers are developing a radically new thermal-aware design approach for next generation energy-efficient datacenters. This new approach integrates the cooling infrastructure definition with system-level power, performance and thermal management, and energy recovery strategies for the complete datacenter. The research carried out is very interdisciplinary: it integrates innovations in several research areas, namely, computer engineering and cooling design, large-scale computing system simulation, software generation and optimization, statistical network modeling and model predictive control theory.

**Thermal storage control.** With increasing penetration of renewable energy sources, power forecast errors increase, threatening grid reliability. To manage the real-time grid energy imbalances, **HeatReserves** seeks to develop control schemes for thermal loads of an aggregation of office buildings and residential households as an economically and environmentally attractive approach to provide additional ancillary services for the Swiss power grid. Already, an integrated building modeling and simulation environment has been built to serve as a testbed for the control schemes being developed. In collaboration with Swissgrid, ancillary service requirements and the market structure have been explored. Furthermore, a market study was conducted to determine factors influencing user acceptance of thermal load demand response schemes.



#### **Inexact sub-near-threshold systems for ultra-low power devices.**

As any portable device today consumes too much energy, the goal of the project **IcySoC** is to reduce significantly the energy used for performing different applications required by customers. Letting microchips make a few mistakes here and there could make them much faster and more energy-efficient: such is the core idea behind the project. It is developing an ultra-low-power platform based on an integrated circuit operated at very low supply voltage (“near- or sub-threshold”) and using inexact computation blocks that provide approximate results tolerated by many applications like video or audio.

Already, the consortium has a clear view of the architecture of the platform comprising multiprocessors, memories, network-on-chip and hardware accelerators. The latter will be designed in inexact logic and the whole platform will be operated at very low supply voltages. Several inexact arithmetic blocks have been identified and designed.

#### **Systems for ultra-high performance photovoltaic energy harvesting.**

The Swiss energy landscape will have to undergo fundamental changes to compensate for the massive losses in electricity production capacity resulting from the phase-out of nuclear power plants. At the same time, electronic devices have recently become more mobile, demanding for ubiquitous energy scavenging to power them while providing minimal surface area that could be used for solar cells. The **Synergy** project is addressing both issues by developing low-cost photovoltaic energy harvesting systems with ultra-high efficiencies. These systems have the potential to provide both the terawatts of sustainable energy needed for future generations as well as to enable a next generation of ubiquitous wearable and electronic applications with integrated power source. This will have a strong impact on the Swiss watch and electronic industries. In addition, these systems have the potential to revolutionize the PV market, and, as a consequence, also the Swiss energy landscape.








### **NANO-TERA FOCUSED PROJECTS COMPLETE THE PICTURE**

In addition to these 25 large-scale multi-disciplinary RTD projects, Nano-Tera also funds the smaller NTF projects (Nano-Tera Focused) addressing specific aspects. Some projects involve smart textiles (3D large-scale integration into smart textiles, or novel textiles for non-invasive monitoring of pressure and oxygenation of tissue), others address different aspects of health monitoring, from night monitoring of blood pressure, to diabetes non-invasive activity monitoring, among others.

## THEMATIC OUTPUT

The Nano-Tera projects can be grouped into thematic clusters related to health, environment and energy. Health-related research is split into health monitoring, smart prosthetics and body repair, and medical platforms. Below is an analysis of the projects output by topic.

<b>Health Monitoring</b> 	<p>FlusiTex • ISyPeM II • NewbornCare • ObeSense • WearMeSoC</p> <p><b>20</b> publications    ►► 7 journal articles + 13 conf. proceedings</p> <p><b>29</b> conference presentations, including 7 invited oral presentations</p> <p><b>1</b> patent</p>
<b>Smart Prosthetics and Body Repair</b> 	<p>HearRestore • MagnetoTheranostics • SmartSphincter • SpineRepair • WiseSkin</p> <p><b>11</b> publications    ►► 4 journal articles + 7 conf. proceedings</p> <p><b>48</b> conference presentations, including 37 invited oral presentations</p> <p><b>2</b> awards</p> <p><b>4</b> patents</p>
<b>Medical Platforms</b> 	<p>BodyPoweredSenSE • MIXSEL II • PATLiSci II • UltraSoundToGo • WearableMRI</p> <p><b>20</b> publications    ►► 6 journal articles + 14 conf. proceedings</p> <p><b>21</b> conference presentations, including 8 invited oral presentations</p> <p><b>1</b> award</p> <p><b>1</b> patent</p>
<b>Environmental Monitoring</b> 	<p>Envirobot • IrSens II • OpenSense II • X-Sense II</p> <p><b>23</b> publications    ►► 4 journal articles + 19 conf. proceedings</p> <p><b>58</b> conference presentations, including 24 invited oral presentations</p> <p><b>2</b> awards</p> <p><b>2</b> patents</p>
<b>Smart Energy</b> 	<p>HeatReserves • IcySoC • SHINE • SmartGrid • Synergy • YINS</p> <p><b>46</b> publications    ►► 8 journal articles + 38 conf. proceedings</p> <p><b>46</b> conference presentations, including 21 invited oral presentations</p> <p><b>1</b> award</p>

## PHASE II PROJECTS, 2013-2017

BodyPoweredSenSE	Wearable ICT for Zero Power medical Applications	Prof. Pierre-André Farine EPFL
Envirobot	Automated surveying of surface water quality by a physical, chemical and biological sensor equipped anguilliform robot	Prof. Jan van der Meer UNIL
FlusiTex	Fabrication of fluorescence sensors integrated into a textile dressing for non-invasive lifetime based wound monitoring	Prof. Bradley Nelson ETHZ
HearRestore	Image-guided micro surgery for hearing aid implantation	Prof. Stefan Weber UniBE
HeatReserves	Demand Response for Ancillary Services: Thermal Storage Control	Prof. John Lygeros ETHZ
IcySoC	Inexact Sub-Near-threshold System for Ultra-Low Power Devices	Prof. Christian Piguet CSEM
IrSens II *	A multi-component sensor for air pollutants and greenhouse gases	Prof. Jérôme Faist ETHZ
ISyPeM II *	Therapeutic drug monitoring for Personalized medicine	Prof. Carlotta Guiducci EPFL
MagnetoTheranostics	From Superparamagnetic Nano-particles until Tools for Detection and Treatment of cancer	Prof. Heinrich Hofmann EPFL
MIXSEL II *	Novel semiconductor disk lasers for biomedical and metrology applications	Prof. Ursula Keller ETHZ
NewbornCare	Newborn Monitoring based on multiple vision sensors	Prof. Pierre Vandergheynst EPFL
ObeSense	Monitoring the Consequences of Obesity	Prof. Jean-Philippe Thiran EPFL
OpenSense II *	Crowdsourcing High-Resolution Air Quality Sensing	Prof. Alcherio Martinoli EPFL
PATLiSci II *	Rapid Sensing of Cancer	Prof. Ernst Meyer UniBas
SHINE	Solar Hydrogen Integrated Nano Electrolysis	Prof. Christophe Moser EPFL
SmartGrid	Smart grids, Smart buildings and Smart sensors for Optimized and Secure Management of Electricity Distribution using dedicated microelectronic ICs and real time ICT	Prof. Maher Kayal EPFL
SmartSphincter	Smart muscles for incontinence treatment	Prof. Bert Müller UniBas
SpineRepair	Hybrid CMOS-polymer neural interfaces for restoration of sensorimotor functions after spinal cord injury	Prof. Stéphanie Lacour EPFL
Synergy	Systems for ultra-high performance photovoltaic energy harvesting	Prof. Christophe Ballif EPFL
UltraSoundToGo	High performance portable 3D ultrasound platform	Prof. Giovanni De Micheli EPFL
WearableMRI	Wearable MRI detector and sensor arrays	Prof. Klaas Prüssmann ETHZ
WearMeSoC	Multi Functional Wearable Wireless Medical Monitoring Based on A Multi Channel Data Acquisition and Communication Management System on a Chip	Prof. Qiuting Huang ETHZ
WiseSkin	Wise Skin for tactile prosthetics	Dr. John Farserotu CSEM
X-Sense II *	MEMS acoustic detectors for natural hazard warning systems	Prof. Lothar Thiele ETHZ
YINS	Energy-and thermal-aware design of many-core heterogeneous datacenters	Prof. David Atienza EPFL

\* Follow-ups of Phase I projects

## SOME NANO-TERA RESEARCHERS

Below are the profiles of some Nano-Tera researchers. Unless otherwise specified, the publications statistics are taken from Google Scholar.

### Prof. Luca Benini, ETHZ

Nano-Tera projects involvement: Co-PI in **IcySoC**, **UltraSoundToGo**, **YINS**

567 publications since 2005 • 26'831 citations (22'424 since 2005) • H-index 78

Research interests: Many-core architecture, Embedded Systems, Low Power, Wireless Sensor Networks, Ambient Intelligence

Key publications:

- Networks on chips: a new SoC paradigm, L. Benini, G De Micheli, Computer 35 (1), 70-78 (2002)
- A survey of design techniques for system-level dynamic power management, L. Benini, A Bogliolo, G De Micheli, Very Large Scale Integration (VLSI) Systems, IEEE Transactions on 8 (3), 299-316 (2000)
- System-level power optimization: techniques and tools, L. Benini, G Micheli, ACM Transactions on Design Automation of Electronic Systems (TODAES) 5 (2), 115-192 (2000)



### Prof. Giovanni De Micheli, EPFL

Nano-Tera project involvement: PI of **UltraSoundToGo**

453 publications since 2005 • 30'402 citations (20'884 since 2005) • H-index 84

Research interests: design technologies for integrated circuits and systems, heterogeneous platform design including electrical components and biosensors, as well as data processing of biomedical information.

Key publications:

- Networks on chips: a new SoC paradigm, L. Benini, G De Micheli, Computer 35 (1), 70-78 (2002)
- Synthesis and Optimization of Digital Circuits, G DE MICHELI, McGraw-Hill, 579p (1994)
- A survey of design techniques for system-level dynamic power management, L. Benini, A Bogliolo, G De Micheli, Very Large Scale Integration (VLSI) Systems, IEEE Transactions on 8 (3), 299-316 (2000)

### Prof. Nico de Rooij, EPFL

Nano-Tera project involvement: Co-PI in **PATLiSci II**

584 publications since 2005 • 18'597 citations (12'087 since 2005) • H-index 70

Research interests: MEMS, NEMS

Key publications:

- Microfluidics meets MEMS, E Verpoorte, NF de Rooij, Proceedings of the IEEE 91 (6), 930-953 (2003)
- Operation of chemically sensitive field-effect sensors as a function of the insulator-electrolyte interface, L Bousse, NF De Rooij, P Bergveld, Electron Devices, IEEE Transactions on 30 (10), 1263-1270 (1983)
- Electrokinetically driven microfluidic chips with surface-modified chambers for heterogeneous immunoassays, A Dodge, K Fluri, E Verpoorte, NF de Rooij, Analytical chemistry 73 (14), 3400-3409 (2001)



### Prof. Jérôme Faist, ETHZ

Nano-Tera project involvement: PI of **IrSens II**

374 publications since 2005 • 22'469 citations (15'671 since 2005) • H-index 74

Research interests: Quantum Cascade Laser, microcavity, strong coupling, Terahertz

Key publications:

- Quantum cascade laser, J Faist, F Capasso, DL Sivco, C Sirtori, AL Hutchinson, AY Cho, Science 264 (5158), 553-556 (1994)
- Continuous wave operation of a mid-infrared semiconductor laser at room temperature, M Beck, D Hofstetter, T Aellen, J Faist, U Oesterle, M Illegems, E Gini, H Melchior, Science 295 (5553), 301-305 (2002)
- High-power directional emission from microlasers with chaotic resonators, C Gmachl, F Capasso, EE Narimanov, JU Nöckel, AD Stone, J Faist, DL Sivco, AY Cho, Science 280 (5369), 1556-1564 (1998)

### Prof. Hubert Girault, EPFL

Nano-Tera project involvement: Co-PI in **Envirobot**

257 publications since 2005 • 14'955 citations (10'547 since 2005) • H-index 64

Research interests: Electrochemistry

Key publications:

- UV laser machined polymer substrates for the development of microdiagnostic systems, MA Roberts, JS Rossier, P Bercier, H Girault, Analytical Chemistry 69 (11), 2035-2042 (1997)
- Mixing processes in a zigzag microchannel: finite element simulations and optical study, V Mengeaud, J Josserand, HH Girault, Analytical Chemistry 74 (16), 4279-4286 (2002)
- Electrochemistry of liquid-liquid interfaces, HHJ Girault, DJ Schiffrin, Electroanalytical chemistry 15, 1-141 (1989)



### Prof. Michael Grätzel, EPFL

Nano-Tera projects involvement: Co-PI in **SHINE, Synergy, TANDEM**

621 publications since 2005 • 141'140 citations (113'950 since 2005) • H-index 181

Research interests: nanocrystalline junctions, photovoltaic cells, light energy conversion & storage...

Key publications:

- Photoelectrochemical cells, M Grätzel, Nature 414 (6861), 338-344 (2001)
- Conversion of light to electricity by cis-X2bis (2, 2'-bipyridyl-4, 4'-dicarboxylate) ruthenium (II) charge-transfer sensitizers (X= Cl-, Br-, I-, CN-, and SCN-) on nanocrystalline titanium dioxide electrodes, MK Nazeeruddin, A Kay, I Rodicio, R Humphry-Baker, E Müller, P Liska, N Vlachopoulos, M Grätzel, Journal of the American Chemical Society 115 (14), 6382-6390 (1993)
- Light-induced redox reactions in nanocrystalline systems, A Hagfeldt, M Graetzel, Chemical Reviews 95 (1), 49-68 (1995)



### Prof. Ursula Keller, ETHZ

Nano-Tera project involvement: PI of **MIXSEL II**

412 publications since 2005 • 19'555 citations (13'838 since 2005) • H-index 74

Research interests: Physics, Ultrafast Science, Laser Physics, Attosecond Science

Key publications:

- Semiconductor saturable absorber mirrors (SESAM's) for femtosecond to nanosecond pulse generation in solid-state lasers, U Keller, KJ Weingarten, FX Kartner, D Kopf, B Braun, ID Jung, R Fluck, C Honninger, N Matuschek, J Ausder Au, Selected Topics in Quantum Electronics, IEEE Journal of 2 (3), 435-453 (1996)
- Recent developments in compact ultrafast lasers, U Keller, Nature 424 (6950), 831-838 (2003)
- Solid-state low-loss intracavity saturable absorber for Nd: YLF lasers: an antiresonant semiconductor Fabry-Perot saturable absorber, U Keller, DAB Miller, GD Boyd, TH Chiu, JF Ferguson, MT Asom, Optics letters 17 (7), 505-507 (1992)



### Prof. Jean-Yves Le Boudec, EPFL

Nano-Tera project involvement: Co-PI in **SmartGrid**

192 publications since 2005 • 19'516 citations (15'255 since 2005) • H-index 66

Research interests: Performance Evaluation, Networking, Smart Grid

Key publications:

- Performance analysis of the CONFIDANT protocol, S Buchegger, JY Le Boudec, Proceedings of the 3rd ACM international symposium on Mobile ad hoc networking & computing, ACM, 226-236 (2002)
- Network calculus: a theory of deterministic queuing systems for the internet, JY Le Boudec, P Thiran, Springer-Verlag (2001)
- A robust reputation system for mobile ad-hoc networks, S Buchegger, JY Le Boudec, LCA-REPORT-2003-023 (2003)



### Prof. Ernst Meyer, Uni Basel

Nano-Tera project involvement: PI of **PATLiSci II**

152 publications since 2005 • 17'748 citations (11'453 since 2005) • H-index 66

Research interests: Physics

Key publications:

- Translating biomolecular recognition into nanomechanics, J Fritz, MK Baller, HP Lang, H Rothuizen, P Vettiger, E Meyer, H-J Güntherodt, Ch Gerber, JK Gimzewski, Science 288 (5464), 316-318 (2000)
- Multiple label-free biodetection and quantitative DNA-binding assays on a nanomechanical cantilever array, R McKendry, J Zhang, Y Arntz, T Strunz, M Hegner, HP Lang, MK Baller, U Certa, E Meyer, H-J Güntherodt, Ch Gerber, Proceedings of the National Academy of Sciences 99 (15), 9783-9788 (2002)
- Noncontact atomic force microscopy, Springer (2002)





### Prof. Demetri Psaltis, EPFL

Nano-Tera project involvement: Co-PI in **SHINE**  
 156 publications since 2005 • 10'949 citations (5'884 since 2005) • H-index 56\*

Research interests: optofluidics, biophotonics, nonlinear optics, holography, optical information processing

#### Key publications:

- Developing optofluidic technology through the fusion of microfluidics and optics, D. Psaltis, SR Quake, CH Yang, Nature 442 (7101), 381-386 (2006)
- Non-volatile holographic storage in doubly doped lithium niobate crystals, K. Buse, A. Adibi, D. Psaltis, Nature 393 (6686), 665-668 (1998)
- Optical implementation of the Hopfield model, NH. Farhat, D. Psaltis, A. Prata, E. Paek, Applied Optics 24 (10), 1469-1475 (1985).

### Prof. Philippe Renaud, EPFL

Nano-Tera projects involvement: Co-PI in **Envirobot**, **ISyPeM II**  
 272 publications since 2005 • 11'644 citations (9'413 since 2005) • H-index 56

Research interests: bioMEMS, microfluidics, nanofluidics

#### Key publications:

- SU-8: a low-cost negative resist for MEMS, H Lorenz, M Despont, N Fahrni, N LaBianca, P Renaud, P Vettiger, Journal of Micromechanics and Microengineering 7 (3), 121 (1997)
- Transport phenomena in nanofluidics, RB Schoch, J Han, P Renaud, Reviews of Modern Physics 80 (3), 839 (2008)
- High-aspect-ratio, ultrathick, negative-tone near-UV photoresist and its applications for MEMS, H Lorenz, M Despont, N Fahrni, J Brugger, P Vettiger, P Renaud, Sensors and Actuators A: physical 64 (1), 33-39 (1998)



### Prof. Joseph Sifakis, EPFL

Nano-Tera project involvement: Co-PI in **UltraSoundToGo**  
 112 publications since 2005 • 14'356 citations (8253 since 2005) • H-index 55

Research interests: software engineering, formal methods, web services, middleware, networks

#### Key publications:

- The algorithmic analysis of hybrid systems, R Alur, C Courcoubetis, N Halbwachs, TA Henzinger, PH Ho, X Nicollin, A Olivero, J Sifakis, S Yovine, Theoretical computer science 138 (1), 3-34 (1995)
- Specification and verification of concurrent systems in CESAR, JP Queille, J Sifakis, International Symposium on Programming, 337-351 (1992)
- Symbolic model checking for real-time systems, TA Henzinger, X Nicollin, J Sifakis, S Yovine, Information and computation 111 (2), 193-244 (1994)

### Prof. Lothar Thiele, ETHZ

Nano-Tera projects involvement: PI of **X-Sense II**, Co-PI in **OpenSense II**, **UltraSoundToGo**, **YINS**  
 300 publications since 2005 • 30'019 citations (25'974 since 2005) • H-index 65

Research interests: models and methods for the design of embedded systems, embedded software, networked (wireless) systems, embedded multiprocessor systems, bioinspired optimization techniques

#### Key publications:

- Multiobjective evolutionary algorithms: a comparative case study and the strength Pareto approach, E Zitzler, L Thiele, Evolutionary Computation, IEEE Transactions on 3 (4), 257-271 (1999)
- SPEA2: Improving the strength Pareto evolutionary algorithm, E Zitzler, M Laumanns, L Thiele, E Zitzler, E Zitzler, L Thiele, Eidgenössische Technische Hochschule Zürich (ETH), Institut für Technische Informatik und Kommunikationsnetze 8 (2001)
- Comparison of multiobjective evolutionary algorithms: Empirical results, E Zitzler, K Deb, L Thiele, Evolutionary computation 8 (2), 173-195 (2000)

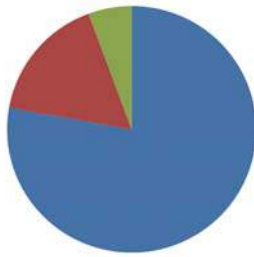


\* Statistics based on Web of Science



## THE NANO-TERA PHD STUDENTS

**Distribution by institution type**



- ETH Board
- Universities
- Hospitals & others

There are 142 PhD students who are (or were) part of a currently running Nano-Tera project.

### DISTRIBUTION OF PHD STUDENTS BY INSTITUTION

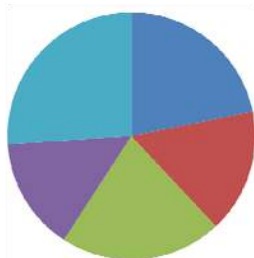
About 78% of all PhD students are affiliated with EPFL, ETHZ or another ETH Board institution, as shown in the graph to the left.

About 17% study in a university or a university of applied sciences. The rest are affiliated with hospitals or other institutions.

### DISTRIBUTION OF PHD STUDENTS BY TOPIC

Based on the thematic clusters described above, the distribution of PhD students by topic is shown in the graph to the left. Currently, 21 PhD students are involved in a project related to environmental monitoring, and 37 are involved in smart energy. The three health-related clusters (health monitoring, smart prosthetics & body repair, medical platforms) have 31, 23 and 30 PhD students respectively.

**Distribution by topic**



- Health Monitoring
- Smart Prosthetics & Body Repair
- Medical Platforms
- Environmental monitoring
- Smart Energy

More precisely, the breakdown by project is as follows:

Health Monitoring	
FlusiTex	0
ISyPeM II	9
NewbornCare	2
ObeSense	7
WearMeSoC	7
<i>Others</i> (NTF, etc.)	6
	<b>31</b>

Smart Prosthetics & Body Repair	
HearRestore	6
MagnetoTheranostics	3
SmartSphincter	4
SpineRepair	6
WiseSkin	4
	<b>23</b>

Medical Platforms	
BodyPoweredSenSE	8
MIXSEL II	7
PATLiSci II	1
UltraSoundToGo	7
WearableMRI	7
	<b>30</b>

Environmental Monitoring	
Envirobot	3
IrSens II	1
OpenSense II	8
X-Sense II	9
	<b>21</b>

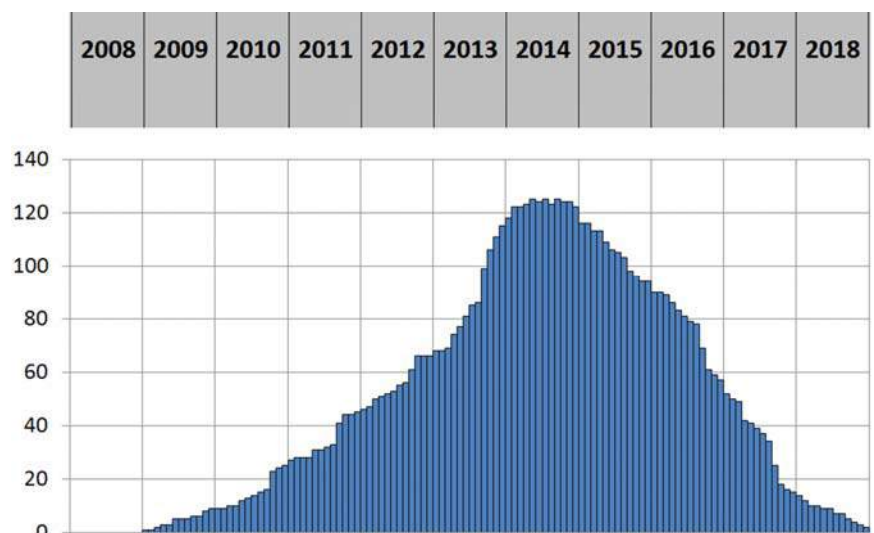
Smart Energy	
HeatReserves	5
IcySoC	3
SHINE	5
SmartGrid	11
Synergy	6
YINS	7
	<b>37</b>

### DISTRIBUTION OF PHD STUDENTS BY GENDER

There are 34 female PhD students, representing about 24% of the total.

### TIMELINE

Based on the starting dates and expected end dates of the PhD students, the graph below indicates how many PhD students are active at any given time.



## THE NANO-TERA PHD STUDENTS

### A PROFILE DIRECTORY OF NANO-TERA PHD STUDENTS

A special page devoted to PhD students has been created on the Nano-Tera website. It consists of a complete directory of all students, which can be sorted and filtered by project, by institution and several other criteria.

The screenshot shows the Nano-Tera website's PhD students directory. On the left is a sidebar with navigation links: NANO-TERA, GEOGRAPHICAL SCOPE, PROJECTS, NEWS, MEDIA COVERAGE, PROGRAM, GOVERNING BODIES, CALL FOR PROPOSALS, JOBS @ NANO-TERA, EVENTS, and INTERACTIVE COMMUNITY. The main content area is titled 'PhD students' and includes a search bar and various filters. The filters are organized into sections: 'By project and topic' (Health Monitoring, Smart Prosthetics & Body Repair, Medical Platforms, Environmental Monitoring, Smart Energy), 'Thematic cluster' (RTD, NTF), 'By institution' (CHUV, CSEM, EMPA, EPFL, ETHZ, HES-SO, Spitaler SH, UniBas, UniBE, UnIGE, UNIL, UNINE, UNISG, USZ, UZH), 'By location' (Basel, Bern, Biel, Dübendorf, Genève, Lausanne, Neuchâtel, Sion, St. Gallen, Zaragoza, Zurich), and 'By starting date' and 'By end date' (from/to). Below the filters is a grid of student profiles, each with a photo, name, institution, project, and dates. A large red banner with the URL 'www.nano-tera.ch/phd' is overlaid on the grid.

**PhD students**

By project and topic:

Thematic cluster

RTD

NTF

By institution:

By location:

By starting date:

By end date:

SEARCH

[www.nano-tera.ch/phd](http://www.nano-tera.ch/phd)

Name	Institution	Project	Start Date	End Date
Enrico Accastelli	EPFL   Lausanne	ISyPeM2	15.12.2009	15.12.2014
Berkur Agir	EPFL   Lausanne	OpenSense2	21.09.2010	31.03.2016
Cesare Allier	ETHZ   Zurich	MIXSEL2	01.11.2014	31.10.2018
Juan Ansó	UNIBE   Bern	HearRestore	01.04.2013	31.03.2016
Adrian Arfieri	EPFL   Lausanne	OpenSense2	01.10.2010	30.09.2015
Nastaran Asadi Zanjani	EPFL   Lausanne	SmartGrid	15.09.2013	31.12.2017
Milad Ataei Ashtiani	EPFL   Neuchâtel	BodyPoweredSense	01.07.2013	30.06.2017
Elham Barzegaran	CHUV   Lausanne	BodyPoweredSense	01.12.2013	30.11.2016
Ivan Beretta	EPFL   Lausanne	BodyPoweredSense	01.03.2010	11.04.2014
Adrien Besson	EPFL   Lausanne	UltrasoundToGo	01.01.2015	31.12.2018
René Blattmann	ETHZ   Zurich	WearableMRI	01.04.2009	31.05.2014
Débora Bonvin	EPFL   Lausanne	MagnetoTherapeutics	01.09.2013	31.08.2017
David Bonzon	EPFL   Lausanne	Envirobot	15.10.2012	14.10.2016
Christopher John Borsa	EPFL   Neuchâtel	BodyPoweredSense	02.06.2013	01.06.2017
Theodor Borsche	ETHZ   Zurich	HeatReserves	01.05.2011	30.04.2015

### THE NEXTSTEP PROGRAM FOR PHD STUDENTS

To strengthen the importance of PhD students within the program, Nano-Tera is setting up a new action specifically for PhD students. This action, called "NextStep", will help them explore possible ways to exploit the scientific skills that they are gaining during their PhD. In particular, NextStep will promote the possibility for them:

- to apply for specific research grants to fund collaborative research involving several PhD students
- to be exposed to different ways of considering economic exploitation of the scientific skills and results obtained during their PhD work

### NANO-TERA WEBSITE

The Nano-Tera website ([www.nano-tera.ch](http://www.nano-tera.ch)) represents one of the main dissemination channels for the Nano-Tera program. The number of visits to the site continues to be monitored and used for decisions related to information dissemination. The traffic has been increasing further, receiving **18%** more visits and **24%** more page views in the reporting period compared to the same period one year earlier.

During the current reporting period, Nano-Tera.ch received more than 100,000 page views corresponding to over 32'000 visits, from **144** countries. For the first time, more than half of the visitors originated from outside Switzerland.

**Nano-Tera: engineering complex systems for health, security, energy and the environment**

The Nano-Tera initiative aims to bring Switzerland to the forefront of a new technological revolution: using engineering and information technology to improve health and security, and to broaden our management of energy and the environment.

**News**   **Video**   **Research**

The Nano-Tera.ch Annual Meeting 2014 was a successful event, with 350 attendees, over 140 posters, and several exciting demonstrations. [read on](#)

**Announcements**

The [Virtual Meeting 2014](#) is available - all the presentations of the Annual Meeting are online.

The Nano-Tera [Research Blog](#) is now online! Please send any contributions to the management office.

**Partners and Participating Institutions**

ETH ZÜRICH   unine   csem   EPFL   UNIVERSITÉ DE GENÈVE

[www.nano-tera.ch](http://www.nano-tera.ch)

## DISSEMINATION AND PROMOTION ACTIVITIES

### NANO-TERA ANNUAL MEETING 2014

The 5<sup>th</sup> Annual Plenary Meeting of Nano-Tera.ch took place on May 20<sup>th</sup>, 2014 at the brand new Swiss Tech Convention Center at EPFL and was a large success thanks to the active participation of all principal investigators, senior scientists and PhD students involved in the projects. This edition had the largest audience of any year: **350 participants**. It showcased more than **140 posters** and **10 videos**. In addition, **7 projects** have featured **demonstrations and early prototypes**.

#### Keynote presentations

Among the program highlights, Prof. Massimiliano Di Ventra of the University of California San Diego, presented a novel computing paradigm named memcomputing inspired by the operation of our own brain.

In the afternoon, Prof. Alessandro Cremonesi, VP at STMicroelectronics, shared his vision of future perspectives for the semiconductor industry, in 2020 and beyond.



Prof. Massimiliano Di Ventra, UCSD



Prof. Alessandro Cremonesi, STMicroelectronics

#### Panel discussions

This year, the event was organized around 5 thematic panel discussions each focusing on a general area of interest in Nano-Tera. The general objective of the sessions was not only to present scientific issues investigated in the projects, but also to provide perspectives regarding their potential applications. In other words, the WHY was just as important as the WHAT and the HOW.

In this perspective, each project leader in the session had a few minutes to briefly present the key challenges in their project, stressing the applications and general usefulness of the research. Afterwards, these main challenges were debated with the audience, in a moderated 20-minute discussion.

As mentioned, the 5 main themes were:

- Health Monitoring
  - Smart Prosthetics & Body Repair
  - Medical Platforms
  - Environmental Monitoring
  - Smart Energy
- FlusiTex • ISyPeM II • NewbornCare • ObeSense • WearMeSoC  
HearRestore • MagnetoTheranostics • SmartSphincter • SpineRepair • WiseSkin  
BodyPoweredSenSE • MIXSEL II • PATLiSci II • UltraSoundToGo • WearableMRI  
Envirobot • IrSens II • OpenSense II • X-Sense II  
HeatReserves • IcySoC • SHINE • SmartGrid • Synergy • YINS



Health Monitoring Panel



Smart Prosthetics & Body Repair Panel



Alcherio Martinoli, in the Environmental Monitoring session



Smart Energy Panel



Medical Platforms Panel

### Best poster awards

Nano-Tera researchers have produced many quality posters, more than 140 this year. To promote this dissemination activity, a best poster competition was once again organized.

All posters presented were evaluated by a jury that ranked the three most outstanding ones, based on their scientific excellence and their ability to present the results in a way that can be understood and appreciated outside their specific research community. The jury was composed of Dr. Iuliana Bacivarov (ETHZ), Dr. Alena Simalatsar (EPFL) and Dr. Cristina Boero (EPFL).



Best poster award jury

The winners are:

- 1<sup>st</sup> place:** *GEEN: Primary Voltage Control for Active Distribution Networks via Real-Time Demand-Response* – **SmartGrid**  
Konstantina Christakou, Dan-Cristian Tomozei, Jean-Yves Le Boudec, Mario Paolone (EPFL)
- 2<sup>nd</sup> place:** *Hardware/ Software Optimizations for Efficient Embedded Digital Signal Processing in Wireless Body Sensor Nodes* – **ObeSense**  
Rubén Braojos, Giovanni Ansaloni, David Atienza (EPFL)
- 3<sup>rd</sup> place:** *Ultrafast vertical external cavity surface-emitting laser (VECSEL)* – **MIXSEL II**  
A.S. Mayer, M. Mangold, C.A. Zaugg, S.M. Link, M. Golling, B.W. Tilma, U. Keller (ETHZ)



Poster awards winners congratulated by Prof. Giovanni De Micheli, Nano-Tera.ch Program Leader.  
From left to right: K. Christakou (1<sup>st</sup> place), R. Braojos (2<sup>nd</sup> place), A. Mayer (3<sup>rd</sup> place)

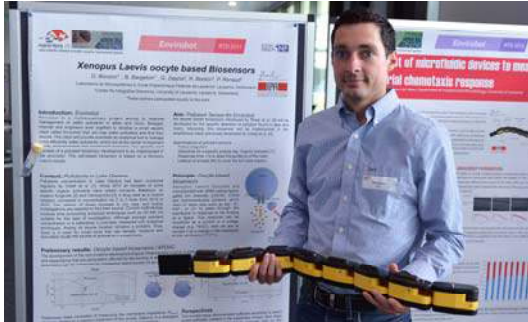
## DISSEMINATION AND PROMOTION ACTIVITIES

### Exhibition

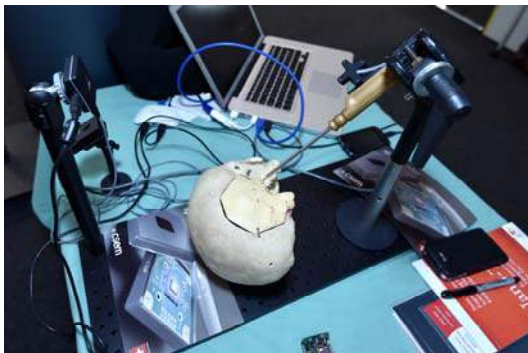
Even though the projects had only started one year prior to the meeting or less, as many as 10 projects already provided a short **video** contribution, displayed on large screens provided by Nano-Tera.

Most importantly, 7 projects have presented **early prototypes or demonstrations** allowing the meeting participants to get a clearer idea of the challenges being tackled in the laboratories.

Examples of demonstrators included:



The **Envirobot** project featured a prototype of an anguilliform robot, whose task consists in locating toxic elements in water, such as arsenic or pesticides and finding the source of this pollution.



The **HearRestore** project brought an impressive demonstration illustrating the development of a high accuracy surgical platform for minimally invasive interventions in the ear. The entire robotic system was displayed, showing for example how the positioning of the head is calculated in order ensure a safe and very accurate procedure.



The **OpenSense II** project brought a pollution sensor box mounted on an electrical car, as part of their efforts to produce high-resolution maps of urban pollution based on mobile sensors.

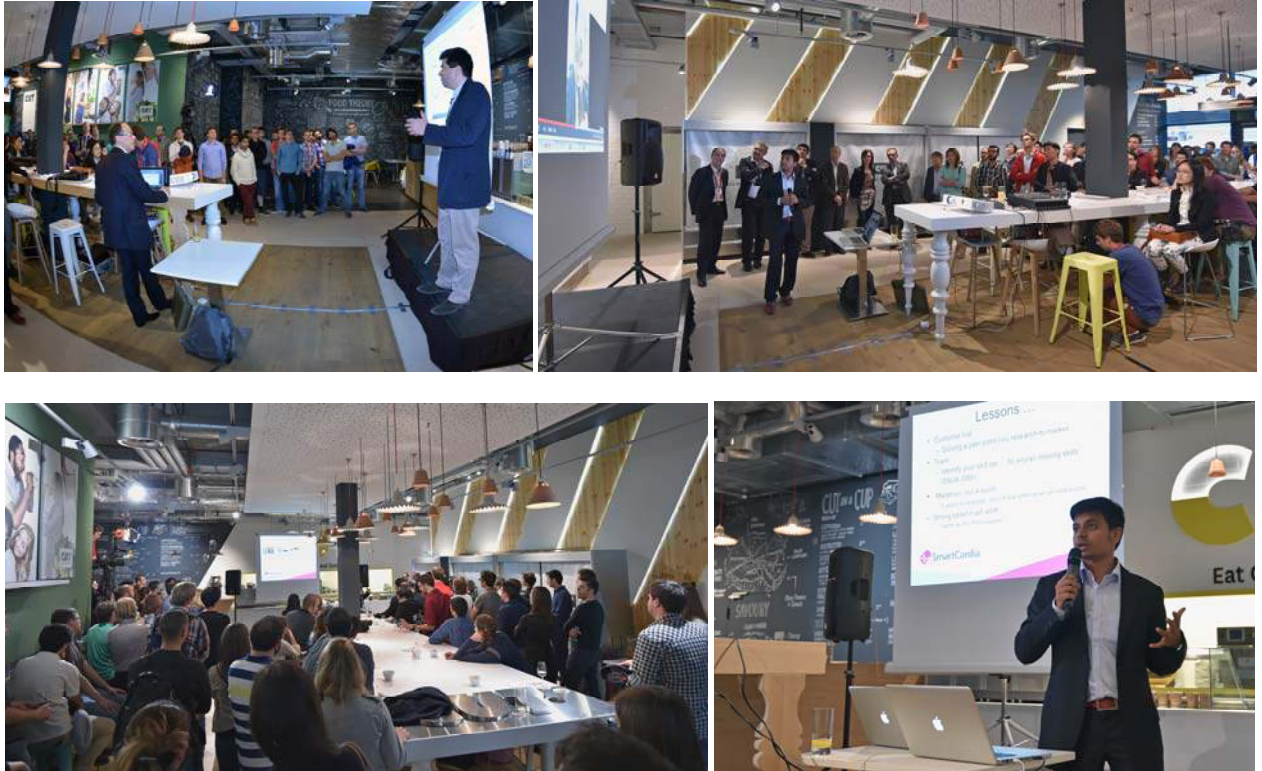


The **SmartGrid** project offered a sophisticated demonstration illustrating the consortium's development of new technologies dedicated to monitoring and managing smart grids in real time.

### Satellite Event for PhD Students

This year, Nano-Tera.ch organized a special event for PhD students, the evening before the main meeting. The main goals of this satellite event were to give to the Nano-Tera PhD students the opportunity to better know each other and exchange about the various research topics they are involved in, and also to provide them with concrete information on how the results they will be achieving in their PhD work might be further exploited in an entrepreneurial perspective.

After a welcome drink in a campus café, the PhD students have been given presentations on the possibilities for exploitation of their work in terms of startups, spin-off, tech transfer, etc.



The event was followed by a dinner and an evening extension at the campus pub, which gave the students the chance to share their experiences and get to know each other.

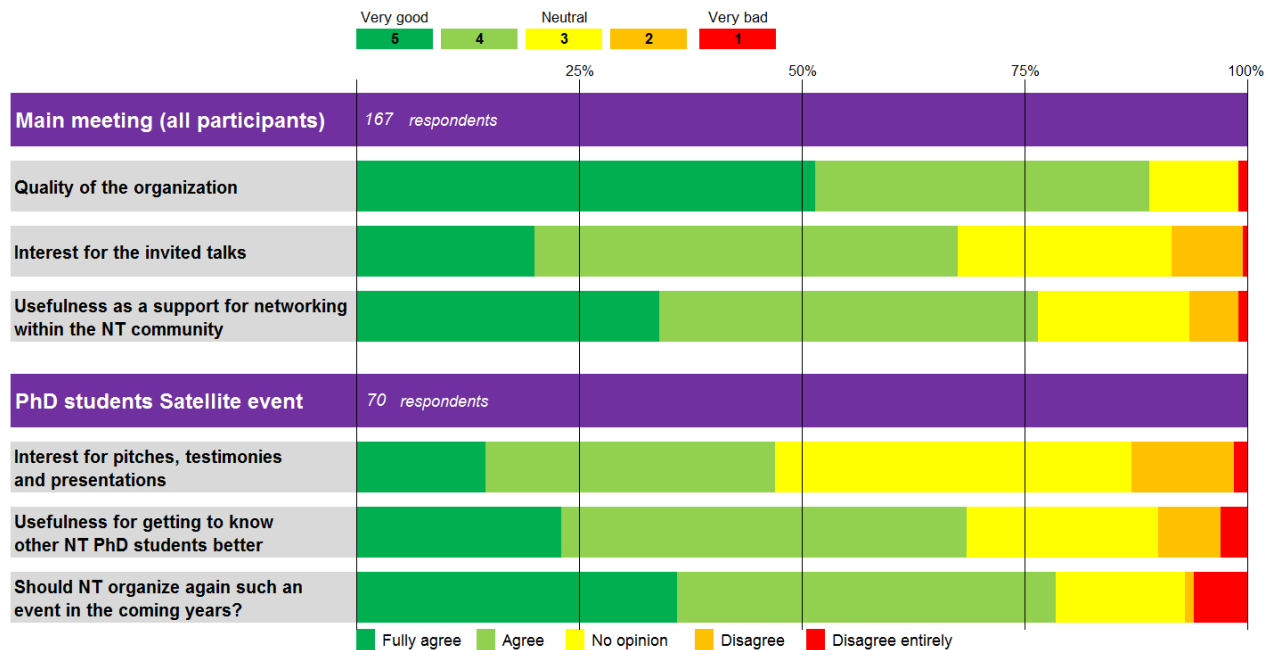


## DISSEMINATION AND PROMOTION ACTIVITIES

### A positive feedback from participants

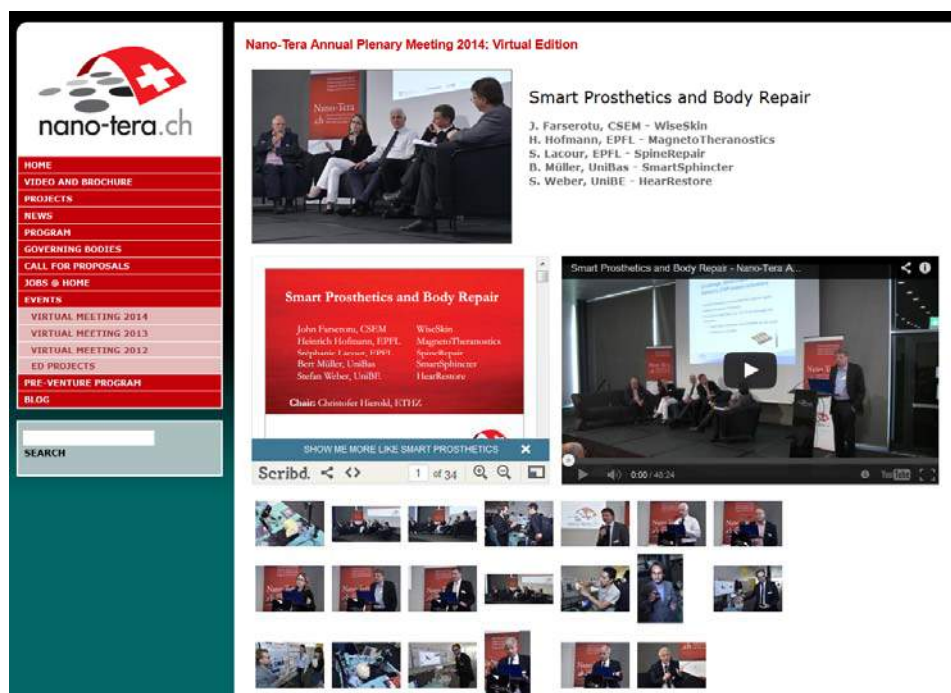
Half of all participants provided us with their feedback by replying to an evaluation survey following the meeting. Among the respondents, a combined 89% rated the organization of the meeting as either good or very good (see results below). Moreover, 68% of respondents rated their interest for the invited talks favorably, and 8% unfavorably. Finally, the meeting was deemed useful as a support for networking within the Nano-Tera community by 77% of respondents.

The special satellite event for PhD students which was organized the evening before the main meeting also garnered positive feedback from students, 70 of whom completed the evaluation survey (out of about 100 participants). In particular, the participants have been overwhelmingly in favor of Nano-Tera organizing a similar event in the coming years: 78% in favor vs. 7% against.



### Virtual Annual Meeting

Like last year, all the content of the annual meeting 2014 has been made available online. The videos of all the presentations can be browsed via a virtual meeting platform at <http://www.nano-tera.ch/events/virtual2014.html>. All the posters presented at the meeting are accessible on the corresponding project pages.



Nano-Tera.ch virtual annual meeting platform

## INFO DAYS FOR INDUSTRIAL PLAYERS

Nano-Tera organized information days for industrial players in March 2014. In the perspective of technology transfer toward the industry, the objective of the information sessions was to present the industrial potential of some of the projects financed in the period 2008-2012. The presentations have been followed by an interaction with the participants in order to discuss the various possibilities for industrial involvement in the program.

The first Info Day was held on March 12<sup>th</sup> in Yverdon with presentations in French from 6 Co-PIs. There were **86 participants** from various companies, ranging from Logitech to Piaget.



The second Info Day was held on March 25<sup>th</sup> in Zurich with presentations in German from the same 6 projects and mostly different Co-PIs. There were **48 participants** from various companies, including ABB, Alstom or Phonak.



General introductory video on Nano-Tera



Dr. Harry Heinzelmann presenting PATLiSci



Prof. Karl Aberer presenting OpenSense



Prof. Gerhard Tröster presenting TecInTex



4 RÉGION

## SCIENCE Un labo neuchâtelois de l'EPFL pilote un projet aux enjeux énormes. Le corps producteur d'électricité

RECHERCHE

Des centaines de milliards de neurones composent le système nerveux humain. Ils sont capables de produire de l'électricité, mais à un niveau très faible. Les chercheurs de l'EPFL ont développé un dispositif capable de mesurer cette production d'électricité à l'échelle du neurone. Ce dispositif est basé sur des électrodes fabriquées à partir de nanomatériaux. Elles sont capables de détecter les minuscules courants électriques produits par les neurones. Les chercheurs ont ainsi pu observer comment les neurones communiquent entre eux. Cette découverte ouvre de nouvelles perspectives pour la compréhension des maladies neurodégénératives.



**NANO-TERA, C'EST QUOI ?**  
C'est un projet de recherche financé par le gouvernement suisse et l'EPFL. Il vise à développer des technologies basées sur les nanomatériaux pour la médecine et l'industrie. Le projet est dirigé par le professeur Jean-Louis Laversin.

**Nous devons récolter le plus d'énergie possible en développant des appareils qui en consomment très peu.**



Alors que nous sommes capables de produire de l'énergie, nous ne sommes pas capables de la récolter. C'est pourquoi nous devons développer des appareils qui en consomment très peu. C'est le défi que nous nous sommes fixé.

Les petits points blancs sur le visage du patient sont des électrodes fabriquées à partir de nanomatériaux. Elles sont capables de détecter les minuscules courants électriques produits par les neurones.



## Pfunde verlieren mit Diät-Shirt

ST. GALLEN Kleidungsstücke mit Sensor an sollen verschiedene Körperfunktionen messen und so Übergewichtigen beim Abnehmen helfen.

Immer mehr Menschen wiegen zu viel, auch in der Schweiz. Das Gesundheitsamt empfiehlt, Übergewichtigen beim Abnehmen zu helfen. Ein T-Shirt mit Sensoren könnte Menschen zum Abnehmen motivieren. Das T-Shirt misst verschiedene Körperfunktionen wie den Herzschlag, den Blutdruck und die Temperatur. Diese Daten werden auf einem Smartphone gespeichert. Die Forscher hoffen, dass diese Informationen Menschen motivieren, mehr zu bewegen und besser zu essen.

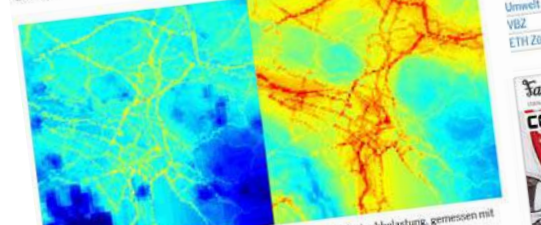
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# Tages-Anzeiger



## Trams messen Luftverschmutzung

Die ETH hat an zehn Zürcher Trams mobile Messstationen installiert. Sie liefern eine genaue Karte zur Schmutzbelastung der Stadtzürcher Luft.



Deutlicher Unterschied zwischen Frühling und Winter: Karte der Feinstaubbelastung, gemessen mit mobilen Sensoren. Bild: ETH Zürich

Seit zwei Jahren sammeln an zehn Zürcher Trams installierte Messstationen Daten zur Luftverschmutzung in Zürich. Die Messstationen liefern auf 100 Meter genau, wie die ETH am 13.01.2014

20 March 2013 Last updated at 01:49 GMT

## 'Under the skin' blood-testing device developed

By Michelle Roberts  
Health editor, BBC News online

Scientists say they have developed a tiny blood-testing device that sits under the skin and gives instant results via a mobile phone.

The Swiss team say the wireless prototype is an inch (14mm) long - can simultaneously for up to five different substances in the blood.



## Schnelltest der ETH soll Kokser entlarven

ZÜRICH Schon bald sollen Drogen im Blut von Autofahrern so einfach nachgewiesen werden wie mit einem Alkoholbluttest. Forscher der ETH Zürich haben eine Methode entwickelt, mit der Kokain innerhalb von Minuten nachweisbar ist.

Die Forscher hoffen, dass diese Methode die Arbeit der Polizei erleichtern wird. Sie haben ein schnelles Testgerät entwickelt, das in wenigen Minuten das Ergebnis liefert.

## Drogen-Schnelltest soll der Polizei die Arbeit erleichtern

ZÜRICH Forscher der ETH Zürich arbeiten an einem Test, der in nur wenigen Minuten zeigt, ob ein Fahrer Drogen konsumiert hat. Die Polizei könnte so schneller entscheiden, ob ein Fahrer eine Straßensperre benötigt.

Die Forscher hoffen, dass diese Methode die Arbeit der Polizei erleichtern wird. Sie haben ein schnelles Testgerät entwickelt, das in wenigen Minuten das Ergebnis liefert.

Die Grundlagen ihrer Forschung haben die Forscher nun im Fachmagazin 'Drug Testing and Analysis' vorgestellt. Das Prototyp ist simpel: Es wird eine Speichelprobe genommen, die Drogen mit einem Lösungsmittel daraus extrahiert und in einen Detektor gegeben. Mittels der sogenannten ATR-Fluoreszenzspektroskopie werden dann die verschiedenen Substanzen nachgewiesen.

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## Die Bergdoktoren

Wegen steigender Temperaturen schmilzt in den Bergen mittlerweile auch das ewige Eis. Die Folge: Geröll- und Eislawinen, die ganze Dörfer bedrohen. Forscher der ETH und der Universität Zürich versuchen nun im Walliser Maderatal, den Permafrost und sein Verhalten besser zu verstehen.

## LE MAG INNOVATION

## Le bon dosage en quelques minutes

Une recherche médicale menée par l'Institut Technologies du vivant



Grâce aux progrès de la recherche, des médicaments sont de mieux en mieux en charge. Il est donc important de trouver le bon dosage pour chaque patient. Les chercheurs de l'Institut Technologies du vivant ont développé un dispositif capable de mesurer le dosage d'un médicament dans le sang en quelques minutes.

Les chercheurs de l'Institut Technologies du vivant ont développé un dispositif capable de mesurer le dosage d'un médicament dans le sang en quelques minutes. Ce dispositif est basé sur des nanomatériaux. Ils sont capables de détecter les minuscules courants électriques produits par les neurones.

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# Swiss Research Program Nano-Tera .ch

## Engineering Multi-Scale Systems for Health, Security, Energy and the Environment



Prof. Giovanni  
De Micheli  
Nano-Tera.ch  
Program  
Leader

### A successful funding program

- 2008-2012**
- 77** research projects funded • **130,000,000** US\$ total budget
  - 700** researchers • **180** PhD students
  - 750** publications • **1,300** presentations worldwide • **37** awards
- 2013-2016**
- 41** new research projects • **100,000,000** US\$ total budget

**Taking  
nanotechnology  
from the labs into  
our daily lives**

### Concrete results: from environmental monitoring to intelligent textiles

Nano-Tera.ch has achieved outstanding results in the areas of biosensing, design of medical implants and diagnosis tools, and monitoring systems for the environment. Success stories include:

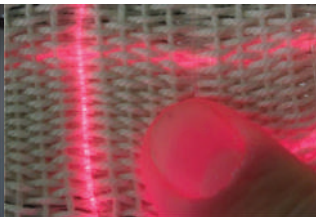
- ✓ sensors for biomarkers in the bloodstream
- ✓ wearable ECG with wireless data transmission
- ✓ electro-optical textiles for monitoring skin ulcers
- ✓ 3-dimensional integrated circuits with fluidic cooling
- ✓ networked rock-displacement detectors to protect against rockslides



Monitoring alpine mass movements at multiple scales



Optical sensing platform to detect doping agents in saliva



Smart sensor-equipped textiles, able to monitor tissue oxygenation



Real-time ECG device, for example in the context of obesity monitoring



Novel surgical platform for minimally invasive interventions in the ear

### A dense research network

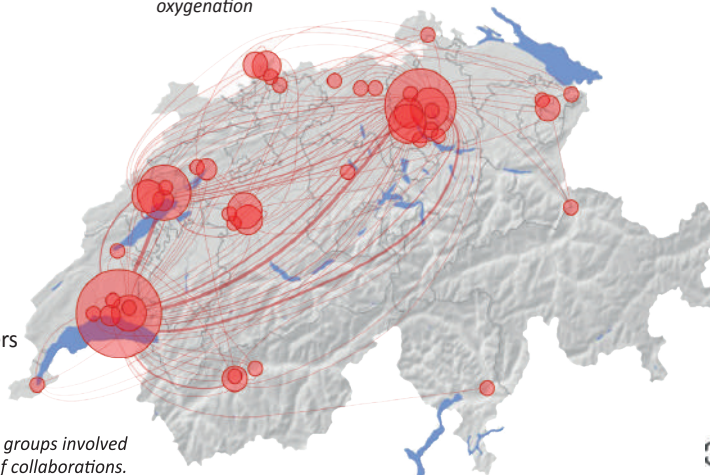
#### 50 Swiss research institutions

- ✓ the two Swiss Polytechnics (EPFL, ETHZ)
- ✓ 9 universities
- ✓ 5 universities of applied sciences
- ✓ 6 university hospitals
- ✓ many other public or private partners

#### 61 industrial partners and hospital end-users

- ✓ additional funding of 15,000,000 US\$
- ✓ 24 patents filed

*The nodes indicate the number of research groups involved and the links the number of collaborations.*



Monitored by the Swiss  
National Science Foundation  
Funded by the ETH Board and  
the Swiss University Conference  
Under the general supervision  
of the Swiss State Secretariat  
for Education and Research



# PROJECTS TIMELINE

## PHASE I PROJECTS, 2009-2013

RTD		2009	2010	2011	2012	2013
CabTuRes	C. Hierold					
CMOSAIC	J. Thome					
GreenPower	J.-A. Manson					
i-IronIC	G. De Micheli					
IrSens / IR-N-ox	J. Faist					
ISyPeM / TWPeM	C. Guiducci					
LiveSense	P. Renaud					
MIXSEL	U. Keller					
NanowireSensor	C. Schönenberger					
Nexray / COSMICMOS	A. Dommann					
NutriChip / Ca-NutriChip	M. Gijs					
OpenSense / OpenSense+	K. Aberer					
PATLiSci / MINACEL	H. Heinzelmann					
PlaCiTUS	Q. Huang					
QCrypt	N. Gisin					
SelfSys / SelfSys+	J. Brugger					
SlmOS / SlmOS+	P. Ryser					
TecInTex	G. Tröster					
X-Sense	L. Thiele					

SSSTC		2009	2010	2011	2012	2013
i-Needle	S. Carrara					
M3VSN	T. Braun					
NaNiBo	A. Züttel					
NetCam	J. Lygeros					
SiC-nanomembranes	J. Brugger					
3DOptoChemImage	D. Psaltis					

NTF		2009	2010	2011	2012	2013
BioAnt	A. Skrivervik					
BioCS-Node	P. Vanderghenst					
EMoA	F. Tièche					
Enabler	A. Ionescu					
G-DEMANDE	M. Schumacher					
MicroComb	T. Kippenberg					
NanoUp	A. Sienkiewicz					
NaWiBo	T. Zambelli					
NeoSense	M. Wolf					
PMD-Program	S. Maerkl					
SecWear	M. Sami					
SMTS	C. Dürager					
TWIGS	D. Briand					
ULP-Logic	Y. Leblebici					
ULP-Systems	Y. Leblebici					

## PHASE II PROJECTS, 2013-2017

RTD		2013	2014	2015	2016	2017
BodyPoweredSenSE	P.-A. Farine					
Envirobot	J. van der Meer					
FlusiTex	B. Nelson					
HearRestore	S. Weber					
HeatReserves	J. Lygeros					
IcySoC	C. Piguet					
IrSens II	J. Faist					
ISyPeM II	C. Guiducci					
MagnetoTheranostics	H. Hofmann					
MIXSEL II	U. Keller					
NewbornCare	P. Vandergheynst					
ObeSense	J.-P. Thiran					
OpenSense II	A. Martinoli					
PATLiSci II	E. Meyer					
SHINE	C. Moser					
SmartGrid	M. Kayal					
SmartSphincter	B. Müller					
SpineRepair	S. Lacour					
Synergy	C. Ballif					
UltraSoundToGo	G. De Micheli					
WearableMRI	K. Prüssmann					
WearMeSoC	Q. Huang					
WiseSkin	J. Farserotu					
X-Sense II	L. Thiele					
YINS	D. Atienza					

NTF		2013	2014	2015	2016	2017
Breathe	M. Liley					
DINAMO	K. Aberer					
IronIC++	S. Carrara					
MiniHolter	J.-M. Vesin					
NAMBP	J. Solà					
ParaTex	M. Wolf					
TANDEM	A. Weidenkaff					
3D-SensTex	D. Briand					
3D-Systems	Y. Leblebici					

## GOVERNING BODIES

### THE EXECUTIVE COMMITTEE

The Executive Committee (ExCom) acting on behalf of the Steering Committee, is the scientific executive body of Nano-Tera.ch; it consists of scientists from the partner institutions appointed by the Steering Committee and is chaired by the spokesperson of Nano-Tera.ch; it is responsible for defining and monitoring the scientific and academic strategy of the program and for providing scientific guidance.



Dr. Alex Dommann  
EMPA



Prof. Boi Faltings  
EPFL



Prof. Christofer Hierold  
ETHZ



Prof. Qiuting Huang  
ETHZ



Prof. Miroslaw Malek  
USI



Prof. Giovanni De Micheli  
Chair, EPFL



Prof. Nico de Rooij  
EPFL



Dr. Michel Despont  
CSEM



Prof. Hugo Zbinden  
UniGE

### THE STEERING COMMITTEE

The Steering Committee (SC), representing the Presidents, Rectors, CEO of the partners of the Nano-Tera.ch consortium; The Steering Committee is composed of the Rectors, Presidents, Directors, CEOs of the partner institutions involved in the Nano-Tera.ch consortium. The Steering Committee is responsible for all decisions/actions requiring statutory authority, as well as the overall monitoring of the program, including reporting, and the implementing evaluations/recommendations of the Scientific Advisory Board and of the SNSF Evaluation Panel.



Prof. Patrick Aebischer  
Chairman and President  
of EPFL



Prof. Philippe Gillet  
Alternate to the Chair and  
Vice-President for  
Academic Affairs, EPFL



Prof. Ralph Eichler  
President  
ETHZ



Dr. Mario El-Khoury  
CEO  
CSEM



Prof. Antonio Loprieno  
President  
UniBas



Prof. Piero Martinoli  
President  
USI



Prof. Martine Rahier  
President  
UniNE



Prof. Jean-Dominique Vassalli  
Rector  
University of Geneva

### THE SNSF EVALUATION PANEL

The SNSF Evaluation Panel, a group of international experts appointed by SNSF to evaluate the RTD proposals; the selection of the RTD proposal to be funded, as well as their funding level, is decided by SNSF based on the recommendations of the Evaluation Panel.

The current members of the SNSF Evaluation Panel of Nano-Tera.ch are:

- Dr. Amara Amara, ISEP
- Prof. Manfred Bayer, TU Dortmund
- Dr. David Bishop, Boston University
- Prof. Chris Boesch, University of Bern
- Prof. Harald Brune, SNSF
- Prof. Frederica Darema, NSF (USA)
- Dr. Urs Dürig, SNSF
- Prof. Georges Gielen, Leuven University
- Prof. Chih-Ming Ho, UCLA
- Dr. Patrick Hunziker, University of Basel
- Prof. Mary Jane Irwin, Penn State University
- Dr. Karl Knop, SATW
- Prof. Paul Leiderer, SNSF Chair, Uni Konstanz
- Prof. Leila Parsa, Rensselaer Polytechnic Institute
- Prof. Jan Rabaey, University of Berkeley
- Prof. Albert van den Berg, University of Twente
- Prof. Hubert van den Bergh, SNSF

### THE SCIENTIFIC ADVISORY BOARD

The Scientific Advisory Board (SAB) consists of academy and industry representatives from institutions other than the ones participating in the Nano-Tera.ch consortium; it is appointed by the Steering Committee, and provides an external evaluation of the overall performance of the program, as well as recommendations for its improvement.

The current members of the SAB of Nano-Tera.ch are:

- Dr. Andrea Cuomo, STMicro
- Prof. Satoshi Goto, Waseda University
- Prof. Enrico Macii, Politecnico di Torino
- Prof. Heinrich Meyr, SAB Chair, University of Aachen
- Prof. Khalil Najafi, University of Michigan
- Prof. Calton Pu, Georgia Tech
- Prof. Lina Sarro, Technical University Delft
- Prof. Göran Stemme, Royal Institute of Technology Stockholm

### THE NTF EVALUATION PANEL

The NTF Evaluation Panel consists of international experts who have conducted a thorough examination of the NTF proposals, establishing a ranking. The Executive Committee then decided how many of the top proposals could be funded according to the funds available.

The current members of the SAB of Nano-Tera.ch are:

- Dr. Thomas Burg, Max Planck Inst. for Biophys. Chemistry
- Dr. Thomas Ernst, CEA-LETI
- Dr. Victor Erokhin, Università degli studi di Parma
- Prof. Luca Fanucci, Università di Pisa
- Dr. Ahmed Jerraya, CEA-LETI
- Prof. Jan Madsen, Technical University of Denmark
- Dr. Firat Yazicioglu, IMEC

### THE MANAGEMENT OFFICE

The Management Office (MO), responsible for operational tasks, led by an executive director, and involving specific staff for accounting, controlling, reporting, dissemination and web presence; the Management Office is operating under the supervision of the ExCom.



Dr. Martin Rajman,  
Executive Director



Yann Dixon  
Finance & Control  
Coordinator



John Maxwell  
Webmaster



Dr. Patrick Mayor  
Scientific Coordinator



Jocelyne Vassalli  
Administrative Assistant

**Leading house**

EPFL Swiss Federal Institute of Technology Lausanne

**Consortium institutions**

CSEM Swiss Center for Electronics and Microtechnology  
EPFL Swiss Federal Institute of Technology Lausanne  
ETHZ Swiss Federal Institute of Technology Zurich  
UniBas University of Basel  
UniGE University of Geneva  
UniNE University of Neuchâtel  
USI University of Lugano

**Other partners**

ABB  
ACP AG Advanced Circuit Pursuit  
ALP Agroscope Liebefeld-Posieux  
BFH Bern University of Applied Sciences  
BrainServe  
CePO Pluridisciplinary Oncology Center  
CHUV University Hospital of Vaud  
Credit Suisse  
CRR-SUVA Clinique Romande de Réadaptation, SUVA  
Eaton  
Eawag Swiss Federal Institute of Aquatic Science and Technology  
EM EM Microelectronic-Marin  
EMPA Swiss Federal Laboratories for Materials Testing and Research  
FHNW University of Applied Sciences Northwestern Switzerland  
FHO University of Applied Sciences of Eastern Switzerland  
FOEN Federal Office for the Environment  
FSRM Swiss Foundation for Research in Microtechnology  
GAMMA Gamma Remote Sensing  
HES-SO University of Applied Sciences Western Switzerland  
IBM ZRL IBM Zurich Research Laboratory  
Icare Icare Institute  
IDQ id Quantique  
InselSpital Bern University Hospital  
IRB Institute for Research in Biomedicine  
IST Institute for Work and Health  
Kinderspital ZH University Children's Hospital Zurich  
METAS Federal Institute of Metrology  
PSI Paul Scherrer Institute  
REMSMED AG  
Sefar  
Spitäler SH Spitäler Schaffhausen  
SPZ Swiss Paraplegic Center  
ST STMicroelectronics  
SUPSI University of Applied Sciences and Arts of Southern Switzerland  
SwissGrid  
Symbios  
UniBE University of Bern  
UniFR University of Fribourg  
UniSG University of St.Gallen  
UNIL University of Lausanne  
USB University Hospital of Basel  
USZ University Hospital of Zurich  
UZH University of Zurich

**Chinese institutions**

DICP Dalian Institute of Chemical Physics  
PICB Partner Institute for Computational Biology, Shanghai Institute for Biological Sciences  
PKU Peking University  
USTC University of Science and Technology of China, Suzhou  
SIAT Shenzhen Institutes of Advanced Technology



**Program Leader**

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