BSN 2019

Workshop: Bio-Integrated Flexible and Stretchable Electronics for Skin Sensor Networks

2019 Body Sensor Network Workshop

Bio-Integrated Flexible and Stretchable Electronics for Skin Sensor Networks

Organizers: Prof. Gaetano Marrocco (University of Rome Tor Vergata), Dr. Sara Amendola (Radio6ense srl, University of Rome Tor Vergata), Prof. John A. Rogers (University of Northwestern University)

Abstract

The Human skin is a complex, time-evolving interface that constantly conveys two-directional data flux from the internal body toward the external environment and vice versa. Skin transmits biological signals from the inner organs that yield a diagnostic insight into people's health. Skin is moreover our primary protective and perceptual layer and it is continuously sampled by the central nervous system in terms of tactile cues. In a social and psychological context, skin even plays a role in establishing interpersonal bonds.

Pioneered in the last decade by Material scientists with the ambition of re-shaping the flat and rigid conventional wafer-based electronics around the soft and curvilinear surfaces of living organisms, the ***Epidermal Electronics*** has witnessed an unprecedented fertile scientific activity worldwide that resulted in flexible, stretchable and even transient tattoo-like electronics systems whose physical properties, such as thickness, thermal mass and elastic modulus resemble those of the skin. These bio-integrated devices are suitable to tightly adhere to the epidermis, they can sample physio/pathological indicators (temperature, hydration, bio-potentials…) and eventually act as controlled actuators able to trigger therapeutic actions (e.g. the transdermal drugs release).

More recently, the advances in ***Epidermal Electromagnetics***, with research effort given to the design of ad-hoc skin antennas and radiofrequency devices and to the wireless communication, have provided the integrated skin radio-sensors with the capability of wirelessly transmit (even in battery-less mode) clinical-quality data streams toward remote interrogating devices and hence to cloud-based server.

Being able to interact with the body at such an intimate scale, bio-integrated radio-sensors are now going to revolutionize the way we collect, record, and analyze essential parameters of human health, thus boosting the traditional medical model towards future de-centralized, patient-centric participatory digital paradigms. Such technology will moreover permit to replace damaged sensory functions and even to extend the human perception therefore achieving a sensor ultrability.

The proposed workshop aims at drawing the state-of-the-art for skin-like technologies by discussing the latest scientific progress and achievements, the open challenges and the opportunities for future directions. As this research area is at the crossroads of several disciplines (including electronics, electromagnetics, mechanics, materials science, chemistry, biology, medicine, ethics) the workshop will offer the opportunity of fruitful contamination among chemical sensors, electromagnetic components and interconnects, energy harvesting and the smart materials and packaging.

Key topics

- Tattoo-transfer antennas and sensors
- Functionalized, engineered, chemical-loaded ultrathin materials
- Transient, bio-absorbable electronics

- Printed, paper-based and Microfluidic sensors
- Micro/nano fabrication and assembly of flexible circuits
- Electromagnetic modeling of epidermal antennas
- Electromagnetic characterization of bio-compatible membranes
- Epidermal mounted RFID tags and Sensors
- Energy Harvesting
- Application of skin sensors to Wellness, Sports, Healthcare, Assistive Technologies, Soft Robotics

List of Speakers (tentative scheduling)

Time.	*Speaker*	Affiliation	Title
8.30-8.40		**Welcome and Introduction**	
8.40-9.10	1. **Matti Mäntysalo**	Tampere University of Technology	Printed stretchable electronics in wearable biomedical applications
9.10-9.40	2. **Cunjiang Yu**	University of Houston	Fully Elastic Rubbery Electronics, Integrated Devices and Sensory Skins
9.40-10.10	3. **John A. Rogers**	Northwestern University	Soft Electronic and Microfluidic Systems for the Skin
10.10-10.30		***Coffee-break***	
10.30-11.00	4. **Canan Dagdeviren**	Massachusetts Institute of Technology	Wearable and Implantable Devices 'On the Go'
11.00-11.30	5. **Benjamin Tee**	University of Singapore	Towards Bio- and Neuro-mimetic Electronic Skin Sensor Systems
11.30-12.00	6. **Ravinder Dahiya**	Ravinder.Dahiya@glasgow.ac.uk	Energy-Autonomous Conformable Electronic Skin
12.00-12.30	7. **Gaetano Marrocco**	University of Rome Tor Vergata	Toward the Internet of Bodies: Antennas and Propagation of UHF and Emerging 5G Epidermal Systems
12.30-13.30		***Lunch Break***	
13.30-14.00	8. **Woon-Hong Yeo**	Georgia Institute of Technology	Smart and Connected Bioelectronics for Advancing Human Healthcare and Wellness
14.00-14.30	9. **Fiorenzo Omenetto**	Tufts University	Silk-based materials, bioresorbable electronics
14.30-15.00	10. **Joshua Smith**	University of Washington	Flexible sensors for pre-touch and touch sensing
15.00-15.30	11. **Sara Amendola**	University of Rome Tor Vergata Radio6ense srl	Epidermal Finger Augmentation Devices for Sense Restoration
15.30-16.00		***Coffe-break***	
16.00-16.30	12. **John C. Batchelor**	University of Kent	Printable RFID technologies for Sensing Applications on Epidermal mounting or Prosthesis Integration
16.30-17.00	13. **Sheng Xu**	University of California, San Diego	Soft electronics for noninvasive healthcare: from the skin to below the skin
17.00-17.30	14. **Katina Michael**	Arizona State University University of Wollongong Australia	Making the Leap from Wearables to Implantables: Socio-Ethical Issues

Printed stretchable electronics in wearable biomedical applications

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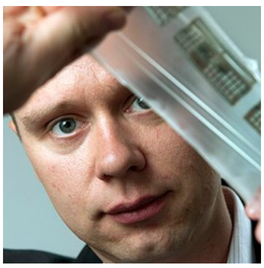
To reach the full potential of wearables, electronics hardware must become soft, light-weight, thin, conformable to the body and, especially, inexpensive to manufacture. The proposed approach is based on low-cost printing processes enabling the wider exploitation of the results, i.e. affordable disposable sensors and e-textiles. Printing electronic components like antennas, interconnects, electrodes, temperature sensors, and pressure sensors on low-cost soft and biocompatible substrates, like thermoplastic polyurethane (TPU), enables continuous (24/7) monitoring. This presentation will focus on utilization of inkjet and screen printing technologies in bio-measurement application.



Matti Mäntysalo is currently a Professor of electronics materials and manufacturing with the Tampere University. His current research interests include printed electronics materials, fabrication processes, stretchable electronics, and especially integration of printed electronics with silicon-based technology (i.e. hybrid systems). He has authored over 100 international journals and conference articles. He has served on the IEEE Electronic Packaging Society, the IEC TC119 Printed Electronics Standardization, and the Organic Electronics Association.

Fully Elastic Rubbery Electronics, Integrated Devices and Sensory Skins

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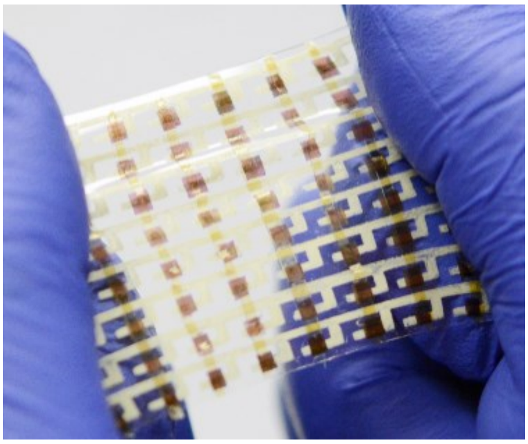

Owing to the merits of mechanical softness and stretchability, stretchable electronics holds promise in many applications including health monitors, medical implants, artificial skins and human-machine interfaces. In general, electronic materials, especially semiconductors, are non-stretchable. Structural designs with special mechanical architectures have been widely adopted to enable the stretchablity in those materials. Alternatively, stretchable electronics could be constructed based on elastic electronic materials. Here, this presentation will introduce the recent progress on developing fully rubbery electronics from intrinsically stretchable rubbery composite materials of semiconductors and conductors, which can be scalably manufactured from common and commercial available materials without dedicated and complicated synthesis. Employing these rubbery electronic materials, fully rubber transistors and sensors, logic gates, active matrices, and elastic sensory skin systems have been realized.

Dr. Cunjiang Yu is the Bill D. Cook Assistant Professor in the Department of Mechanical Engineering at the University of Houston, with affiliate appointments in Electrical and Computer Enginering, Biomedical Engineering and Materials Science and Engineering. The main focus of his research is soft electronics, covering the aspects from fundamentals of manufacturing, materials, mechanics and devices to applications in biomedical, robotics, etc. He has been recoganized by many awards, including the SME Outstanding Young Manufacturing Engineer Award (2019), 3M Non-Tenured Faculty Award (2018), Office of Naval Research Young Investigator Award (2018), MIT Technology Review 35 Top Innovators under age of 35 in China (2017), NSF CAREER Award (2016), ACS Petroleum Research Fund Doctoral New Investigator Award (2016), AVS Young Investigator Award (2015).

Soft Electronic and Microfluidic Systems for the Skin

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Recent advances in materials, mechanics and manufacturing establish the foundations for high performance classes of electronics and other microsystems technologies that have physical properties precisely matched those of the human epidermis. The resulting devices can integrate with the skin in a physically imperceptible fashion, to provide continuous, clinical-quality information on physiological status. This talk summarizes the key ideas and presents specific examples in wireless monitoring for neonatal intensive care, and in capture, storage and biomarker analysis of sweat (see Figure).

John A. Rogers is the Louis Simpson and Kimberly Querrey Professor of Materials Science and Engineering, Biomedical Engineering and Medicine at Northwestern University, with affiliate appointments in Mechanical Engineering, Electrical and Computer Engineering and Chemistry, where he is also Director of the newly endowed Center for Bio-Integrated Electronics. He has published more than 650 papers, is a co-inventor on more than 100 patents and he has co-founded several successful technology companies. His research has been recognized by many awards, including a MacArthur Fellowship (2009), the Lemelson-MIT Prize (2011), and the Smithsonian Award for American Ingenuity in the Physical Sciences (2013) – and most recently the Benjamin Franklin Medal from the Franklin Institute (2019). He is a member of the National Academy of Engineering, the National Academy of Sciences and the American Academy of Arts and Sciences.

Wearable and Implantable Devices 'On the Go'

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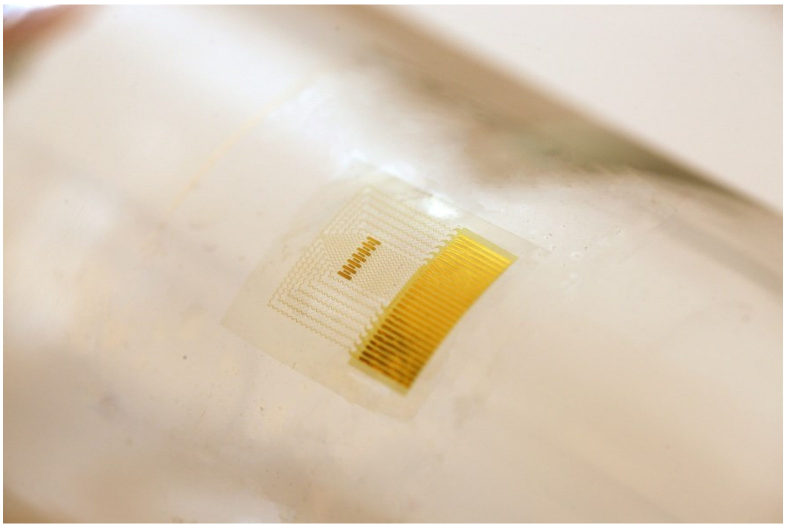

Multifunctional sensing capability, 'unusual' formats with flexible/stretchable designs, lightweight construction, and self-powered operation are desired attributes for electronics that directly interface with the human body. I have focused on novel microfabrication techniques and tricks to use active piezoelectric materials and required electronic components, which have the shape and the mechanical properties that match with those of human tissues, in order to allow intimate integration without any irritation and/or harm to the body. In this talk, I describe novel materials, mechanics and device designs for emerging classes of wearable health monitoring systems and implantable, minimally invasive medical devices. These include a variety of electrodes, sensors, and energy harvesting components, with promising applications in bio-integrated electronics, such as self-powered cardiac pacemakers, wearable blood pressure sensors, modulus sensor patches, and neural drug delivery systems.

Canan Dagdeviren is the LG Career Development Professor of Media Arts and Sciences at MIT Media Lab, where she leads the Conformable Decoders research group. The group aims to convert the patterns of nature and the human body into beneficial signals and energy. Dagdeviren earned her Ph.D. in Materials Science and Engineering from the University of Illinois at Urbana-Champaign, where she focused on exploring patterning techniques and creating piezoelectric biomedical systems. As a Junior Fellow of the Society of Fellows at Harvard University, she conducted her postdoctoral research at the MIT David H. Koch Institute for Integrative Cancer Research. Dagdeviren designed and fabricated multi-functional, minimally invasive brain interfaces that can simultaneously deliver drugs on demand and electrically modulate neural activity precisely and selectively for the treatment of neurological disorders, such as Parkinson's disease.

Printable RFID technologies for Sensing Applications on Epidermal mounting or Prosthesis Integration.

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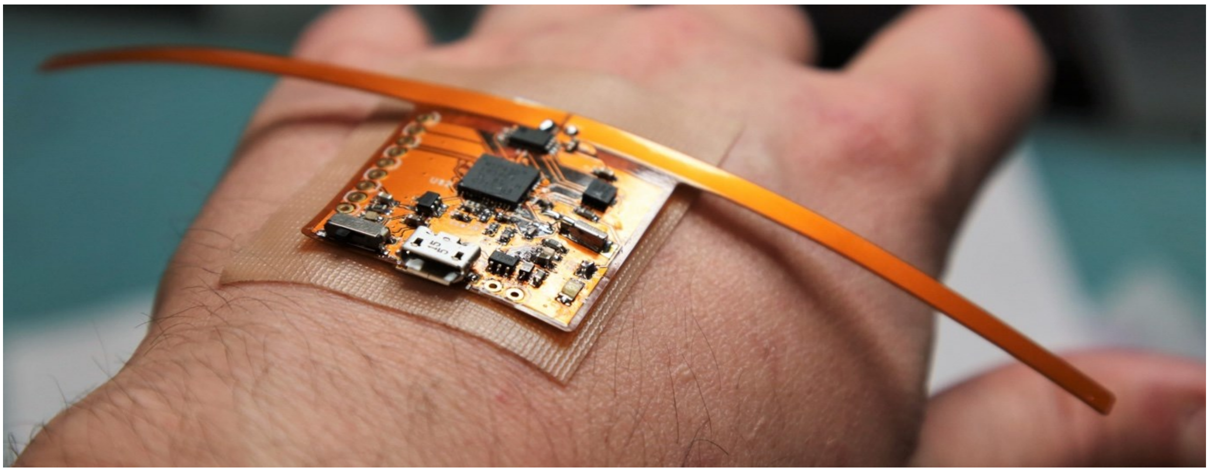

This talk will discuss Ultra High Frequency (UHF) Radio Frequency Identification (RFID) designs proposed for printing on skin mounted substrates and for integration with silicone prostheses. The antennas and sensing mechanisms for passive and for low energy wireless devices will be outlined. Printed RF and instrumentation circuitry suitable for streaming data via an RFID link will be presented together with the limitations of the links. Printed flexible batteries integrated into the device substrates will also be shown as a means to power long term epidermal based monitoring where the link budget will not sustain regular data transfer over links of more than a meter.

John Batchelor is Professor of Antenna Technology at the University of Kent, UK. He specializes in the design and manufacture of printable electronics for epidermal RFID based systems. His current research interests are antennas for epidermal mounting and integration into throat prostheses, bio-compliant and environmentally resorb-able materials, energy harvesting and printed battery integration into epidermal electronics, and sensing via RFID streaming data links.

Energy-Autonomous Conformable Electronic Skin

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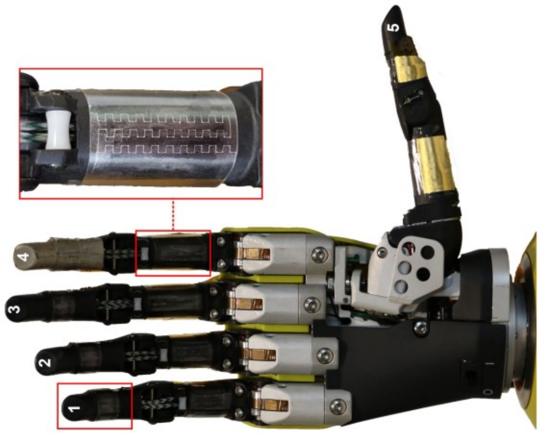

Tactile or electronic skin is critical for haptic perception in robots, prosthetics, as well as, wearable systems. The energy autonomy of skin in these applications is important for portability and longer operation times. In this direction, we have recently obtained novel energy-autonomous flexible and tactile skin, and this will be the focus of the presented work. The developed tactile skin consists of graphene based co-planar capacitive touch sensitive layer integrated on top of flexible photovoltaic cells and supercapacitors. The transparency of the touch sensitive layer is a key feature which allows photovoltaic cell to harvest energy using the light. The touch sensitive layer consumes ultra-low power (20 nW/cm2) and this means the photovoltaic area required to drive the tactile skin is not too large. The fabricated skin detects minimum pressures of 0.11 kPa with a uniform sensitivity of 4.3 Pa-1 along a broad pressure range. Finally, the tactile skin patches were integrated on a prosthetic hand and the response of sensors for static and dynamic stimulus is shown by performing tasks ranging from simple touching to grabbing of soft objects.

Ravinder Dahiya is Professor of Electronics and Nanoengineering and Engineering and Physical Sciences Research Council (EPSRC) Fellow in the School of Engineering at University of Glasgow. He is the Director of Electronic Systems Design Centre (ESDC) and the leader of Bendable Electronics and Sensing Technologies (BEST) group. His group conducts fundamental research on high-mobility materials based flexible electronics and electronic skin, and their application in robotics, prosthetics and wearable systems.

Prof. Dahiya has published more than 250 research articles, 4 books (3 at various publication stages), and 12 patents (including 7 submitted). He has given more than 110 invited/plenary talks. He has led many international projects (> £20 million) funded by European Commission, EPSRC, The Royal Society, The Royal Academy of Engineering, and The Scottish Funding Council.

Toward the Internet of Bodies: Antennas and Propagation of UHF and Emerging 5G Epidermal Systems

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  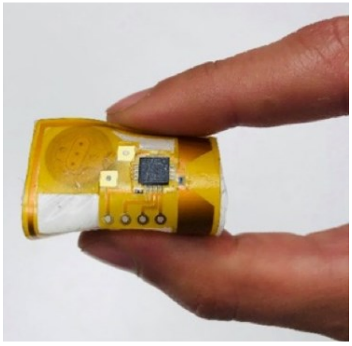

While most of epidermal electronics is intended to be coupled with low-frequency coils for communication with a mobile phone in the very near field (few centimeters read-distance, at most), integrating epidermal sensors with higher-frequency antennas will instead extend the wireless interaction with the skin up to some meters. Biophysical parameters can be automatically collected by the surrounding environment thus enabling the seamless connectivity of human bodies to the Internet of Things.
The talk will introduce the state of the art of the modeling, design, manufacturing and test and real-like applications of epidermal-oriented antenna sensors based on the Radiofrequency Identification standard in the UHF (860-960 MHz) band as well as some potential implementation in the millimeter waves (mmW) in the future 5G communication networks.

Gaetano Marrocco is a full professor of Electromagnetics at the University of Roma Tor Vergata. Italy where he is the director of the Medical Engineering School and Chair of the Pervasive Electromagnetics lab (www.pervasive.ing.uniroma2.it). In 25 years of activity he initially worked on numerical methods for electromagnetic modeling of aerospace, naval, avionic and biomedical devices. Since 2003 he pioneered the design of RFID antennas and sensors for application to bodycentric systems, environmental monitoring, ubiquitous sensing through flying sensors. In the last five years he has been developing epidermal antennas in UHF frequency, integrated with chemical sensors for the measurement of temperature, pH, sweat and breath.
He is co-founder and president of the spin-off Radio6ense (www.radio6ense.com) that is active in the Industrial Internet of Things

Smart and Connected Bioelectronics for Advancing Human Healthcare and Wellness

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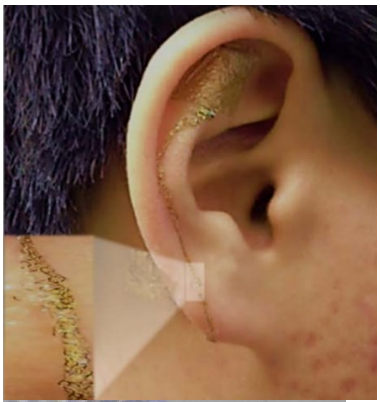

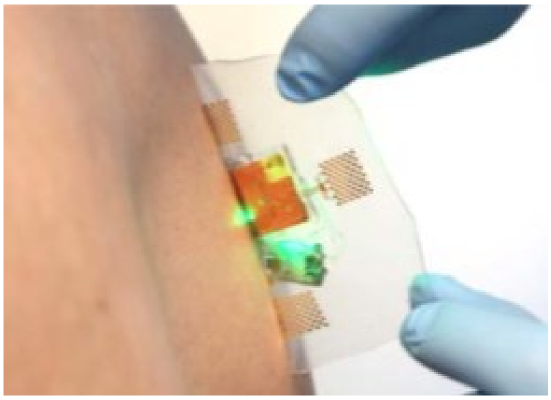

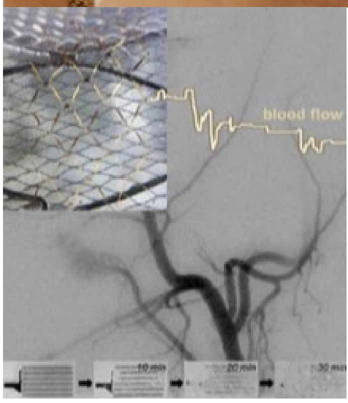

The talk will focuses on the fundamental and applied aspects of nanomechanics, biomolecular interactions, soft materials, and nano-microfabrication for nanoparticle biosensing and unusual electronic system development, with an emphasis on bio-interfaced translational nanoengineering. In this talk, I will discuss about recent research works on soft, smart and connected bioelectronics which include biomimetic materials, mechanics designs, and system integration, aiming for advancing human healthcare and machine interfaces. Specifically, I will talk about some examples of wearable and implantable electronics for ergonomic human-machine interfaces, cardiovascular monitoring, and quantification of hemodynamics.

Dr. Yeo is a TEDx alumnus and biomechanical engineer. Currently, he is an Assistant Professor and the Director of Bio-Interfaced Translational Nanoengineering Group at Georgia Tech. Dr. Yeo received his BS in mechanical engineering from INHA University, Korea in 2003 and received his PhD in mechanical engineering and genome sciences at the University of Washington, Seattle in 2011. From 2011-2013, he worked as a postdoctoral research fellow at the Beckman Institute and Frederick Seitz Materials Research Center at the University of Illinois at Urbana-Champaign. Dr. Yeo is a recipient of a number of awards, including Korea International Technology R&D Collaboration Award, Samsung Global Research Outreach Award, BMES Innovation and Career Development Award, Finalist for Vilcek Prizes for Creative Promise, Virginia Commercialization Award, NSF Summer Institute Fellowship, Notable Korean Scientist Awards, and Best Paper Awards at ASME.

Flexible sensors for pre-touch and touch sensing

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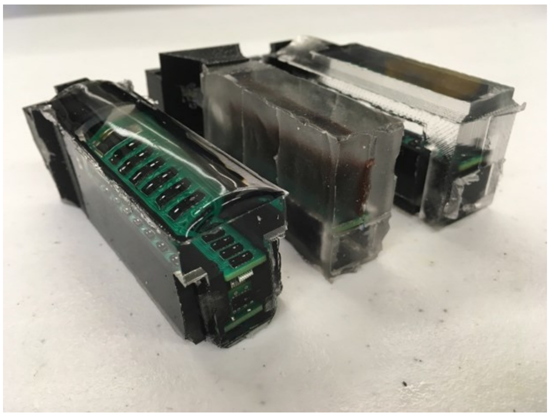

We examine how combined optical proximity, contact, and force sensing can be improved with respect to invariance to object reflectivity, signal-to-noise ratio, and continuous operation when switching between the distance and force measurement regimes. The basic structure of this type of sensor consists of one or more ranging units that have been cast inside of a clear elastomer. Because the elastomer is clear, the sensor can detect and range nearby objects, as well as measure deformations caused by objects that are in contact with the sensors and thereby estimate the applied force. By harnessing time-of-flight technology and optimizing the elastomer-air boundary to control the emitted light's path, we develop a sensor that is able to seamlessly transition between measuring distances of up to 50 mm and contact forces of up to 10 newtons. Furthermore, we provide all hardware design files and software sources, and offer thorough instructions on how to manufacture the sensor from inexpensive, commercially available components.

Joshua R. Smith is the Milton and Delia Zeutschel Professor, jointly appointed in the Allen School of Computer Science and Engineering, and the Department of Electrical and Computer Engineering, at the University of Washington in Seattle. His lab focuses on inventing new sensor systems, devising better ways to power and communicate with them, and building systems that use them. The lab is also active in robotics: including creating new sensor systems developing perception algorithms that make use of these new sensors in robotic applications. The lab's web page is http://sensor.cs.washington.edu/.
Three start up companies have spun out of his lab: Wibotic, Jeeva Wireless, and Proprio.

Towards Bio- and Neuro-mimetic Electronic Skin Sensor Systems

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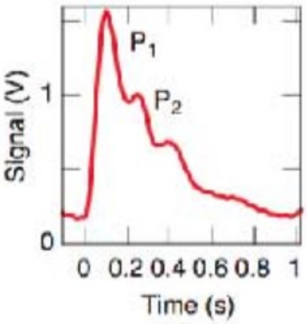

We are in an increasingly connected living environment where humans, smart devices and robots live in synergy together. Continued development of bio-integrable and even neuro-integrable sensory systems will augment human abilities and aid in applications as health diagnostics, surgery and predictive analytics. In my talk, I will discuss materials design and strain engineering techniques to develop materials with stretchability, sensitivity and robust mechanical properties, such as self-healing. In addition, I will also discuss our recent progress in developing new scalable electronic skin platform technologies for more tactile-aware and perceptive systems. It is envisioned that such electronic skins can be useful in future distributed conformable electronic skins, neuro-prosthetic devices and wearable exo-suits in the increasingly digital and augmented human era.

Dr. Benjamin C.K. Tee is appointed President's Assistant Professor in Materials Science and Engineering Department at the National University of Singapore. He obtained his PhD at Stanford University, and was a Singapore-Stanford Biodesign Global Innovation Postdoctoral Fellow in 2014. He has developed and patented several award-winning electronic skin sensor technologies. He is an MIT TR35 Innovator (Global) in 2015 and Singapore National Research Foundation (NRF) Fellow. His research group aims to develop technologies at the intersection of materials science, mechanics, electronics and biology, with a focus on sensitive electronic skins that has tremendous potential to advance global healthcare technologies in an increasingly Artificial Intelligence (AI) era.

Epidermal Finger Augmentation Devices for Sense Restoration

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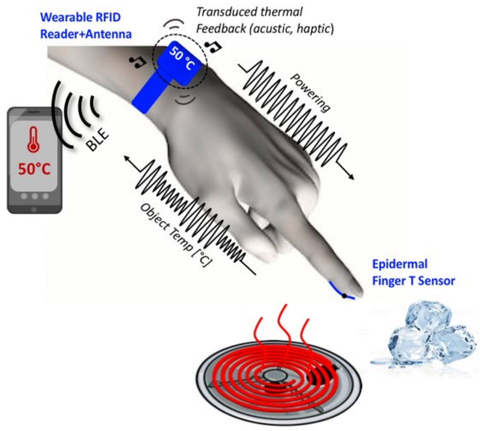
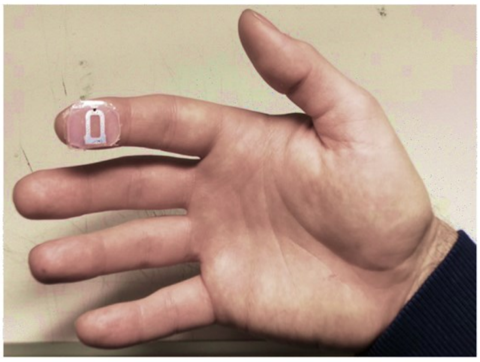
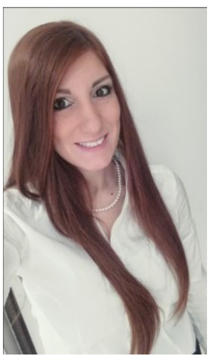





Radiofrequency Finger Augmented Devices (R-FAD) combine the advanced flexible electronics typical of FADs tools with wireless communication based on passive backscattering (UHF RFID) to turn the human fingers into enhanced sensory interfaces aimed at restoring lost peripheral sensitivity in people affected by *Hypoesthesia,* and even expanding their senses beyond natural ones (*ultrability*).
This talk introduces the novel architecture of a R-FAD system comprising battery-less epidermal tag shaped for the fingertip that are powered by and wirelessly interconnected to a wrist-mounted reader module. Starting from the electromagnetic challenges due to the close proximity of the lossy human body, the wrist-to-fingers channel is investigated to derive upper-bounds performance of the wireless link. Fully-functional R-FADs, conceived as assistive devices, are experimented in realistic scenarios to provide impaired subjects with severe loss of thermal feeling or eyesight deficiency with a real-time feedback about the temperature and even the material of the objects they interact with. Finally, the presentation paves the way to original applications of such devices in the context of cognitive neuroscience where it is of great interest to asses if a training with R-FAD providing a 'transduced' physical sensitivity, may trigger the cognitive re-mapping of the abstract/mental representation of the loss sensation



Sara Amendola received her M.Sc. with honors in Medical Engineering from the University of Rome "Tor Vergata" in 2013. In autumn 2013, she joined the "Tampere University of Technology" in Finland as Visiting Researcher, working on the mm-size implantable antennas for Brain–Machine Interface Microelectronic Systems. In December 2015 she was at the ESIEE Paris to investigate microfabrication technologies for epidermal radio-sensors. In May 2017, she achieved the PhD in Computer Science, Robotics and Electromagnetics with distinction at the University of Rome "Tor Vergata", discussing a thesis on Wireless and Battery-less Bio-integrated Sensors for Bodycentric Internet of Things. She is co-founder of the University spin-off RADIO6ENSE, actively involved in the design and development of RFID Sensing and Identification Platforms for Personal Healthcare and Industry 4.0.

Edible, Implantable, Digestible Technologies

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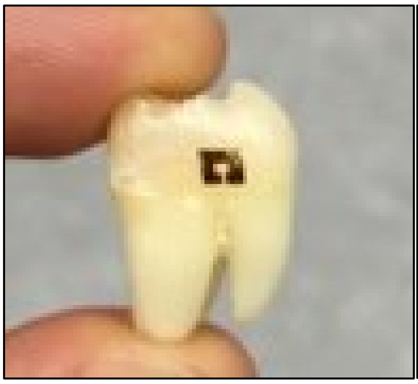

Biopolymers, and structural proteins specifically, are interesting building blocks to engineer materials that recapitulate natural function and performance. The dynamics of molecular self-assembly are at the core of the assembly of materials found in Nature, and result in functional materials that have unique properties like stiffness, toughness, and unusual functionality, all accompanied by structural hierarchy covering dimensions that span from nano- to the macro-scale. The library of such biomaterials include extracellular matrices, nacre, bone, and fibers, all of which possess a heterogeneous, multidimensional structure.

These architectures have been a source of inspiration for fabrication of synthetic counterparts that attempt to mimic their structure and function. The realization of these materials, however, poses a manufacturing challenge given the difficulty of being able to simultaneously control assembly and structure-function properties over such a wide range of dimensional scales: often, control at the molecular level imposes limitations on the control available at larger scales (and vice versa).

The generation of technological, specifically microelectronic and RF structures, with multidimensional control provides an interesting research avenue where structure-function can be designed and explored in new ways. Additionally, the opportunity and ease of doping and entrainment of function allowed by such structures may lead to a new class of designer structures with predefined functions and integration at the interface of technology and biology.

Fiorenzo G. Omenetto is the Frank C. Doble Professor of Engineering, and a Professor of Biomedical Engineering at Tufts University. He also holds appointments in the Department of Physics and the Department of Electrical Engineering. His research interests are at the interface of technology, biologically inspired materials and the natural sciences with an emphasis on new transformative approaches for sustainable, biologically and environmentally integrated materials for high-technology applications. (http://ase.tufts.edu/biomedical/unolab/home.html)

Soft electronics for noninvasive healthcare: from the skin to below the skin

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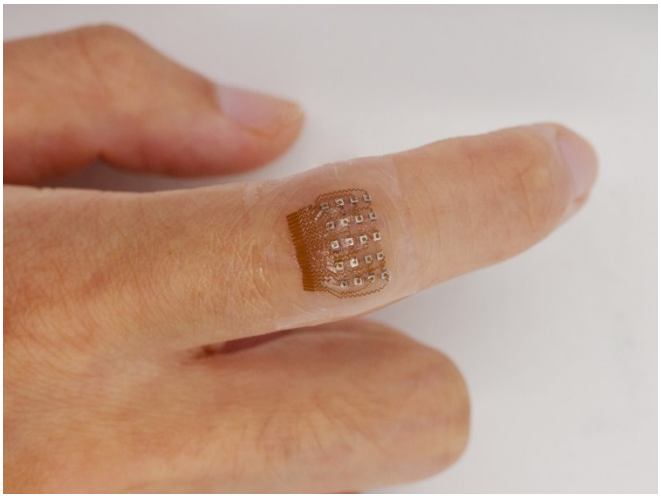

Soft electronic devices that can acquire vital signs from the human body represent an important trend for healthcare. Combined strategies of materials design and advanced microfabrication allow the integration of a variety of components and devices on a stretchable platform, resulting in systems with minimal constraints on the human body. We have demonstrated a skin-mounted multichannel health monitor that can sense local field potentials, temperature, strain, acceleration, and body orientation. Integrating ultrasonic transducers on this stretchable platform adds a third dimension to the detection range by launching ultrasound waves that reach well underneath the skin. The ultrasound waves allow capturing a wide range of dynamic events in deep tissues such as blood pressure and blood flow waveforms in central arteries and veins. This technology holds profound implications for continuous and noninvasive sensing, diagnosis, and treatment of chronic diseases.

Sheng Xu is currently an assistant professor in the Department of Nanoengineering at UC San Diego. He received his B.S. in Chemistry and Molecular Engineering from Peking University in Beijing, China, and Ph.D. in Materials Science and Engineering at Georgia Institute of Technology. He worked as a postdoctoral research associate in Frederick Seitz Materials Research Laboratory at the University of Illinois at Urbana-Champaign. His research group currently focuses on biointegrated electronics for human-machine interface and health monitoring. His research has been recognized by a series of awards, including the NHLBI Technology Development Award, MIT Technology Review Top Innovators Under 35, 3M Non-Tenured Faculty Award, the TSMC Research Gold Award, and the International Union of Pure and Applied Chemistry Prize for Young Chemists.

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Workshop: Bio-Integrated Flexible and Stretchable Electronics for Skin Sensor Networks

Making the Leap from Wearables to Implantables: Socio-Ethical Issues

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Ask someone to strap a device to their body for a period of time to monitor their condition and you're likely to get very little pushback. Tell someone to get a chip injected under their skin and they'll likely tell you that that's just going too far. This presentation provides the results of a qualitative study conducted in 2012 on the social and ethical issues raised by everyday citizens for rejecting non-medical implantable devices for control, care and convenience applications. The empirical data (N=2,556) is rendered from citizens from five countries including: Australia, Canada, United Kingdom, USA and India. Topics related to human rights and privacy, bodily integrity, surveillance and government control, health risks and safety concerns, religious and ideological positions held, and fear and creepiness factors are just some of the issues raised by respondents who would not consent to an implantable being injected into their body. The discussion will ponder on whether the overwhelming citizen sentiment is likely to change over time or whether industry will forge ahead with experimental humancentric IOT systems, for instance, that address emerging areas like blockchain.

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