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Mobile Health Systems Seminar

November 19. & 20., 2018

Location: Main Auditorium of the Balgrist University Hospital (located on the left at the far end from the main entrance), Forchstrasse 340, 8008 Zurich (www.balgrist.ch)

Monday, 19 November 2018

Time	**Speaker**
8.30 – 8.55 h	**Welcome coffee** (foyer in front of auditorium)
9.00 – 9.45 h	**Prof. Dr. Roozbeh Jafari,** Texas A&M University, College of Engineering, USA *"Wearable Computers for Precision Medicine: An Integrated Solution"*
9.50 – 10.35 h	**Prof. Dr. Carlo Menon**, Simon Fraser University, School of Mechatronic Systems Engineering & School of Engineering Science, Canada *"An approach to mobile health"*
10.35 – 10.50 h	Coffee Break
10.50 – 11.35 h	**Prof. Dr. Gari Clifford**, Emory University & Georgia Institute of Technology, Department of Biomedical Informatics, USA *"The elements of a successful mHealth implementation"*
11.40 – 12.25 h	**Artem Dementyev**, Massachusetts Institute of Technology, Media Lab, USA *"Towards ubiquitous health sensing using miniature body roaming robots"*

Tuesday, 20 November 2018

Time	**Speaker**
8.30 – 8.55 h	**Welcome coffee** (foyer in front of auditorium)
9.00 – 9.45 h	**Prof. Dr. Walter Karlen**, ETH Zurich, Mobile Health Systems Lab, Switzerland *"Closing Loops with Mobile Health Systems"*
9.50 – 10.35 h	**Prof. Dr. Oliver Amft**, Friedrich-Alexander Universität, Chair of Digital Health, Germany *"Personal Health Systems"*
10.35 – 10.50 h	Coffee Break
10.50 – 11.35 h	**Prof. Dr. Katarzyna Wac**, University of Copenhagen, Department of Computer Science, Denmark *"Pocket-Size Life Quality: Are We Ready for a Call?"*

Roozbeh Jafari, Ph.D.
Associate Professor, Texas A&M University, http://jafari.tamu.edu/

Title: Wearable Computers for Precision Medicine: An Integrated Solution

Abstract
Our mission is to create integrated and end-to-end mobile health solutions with advanced wearable sensors, robust systems and signal processing methodologies, and supporting analytics. Our integrated solutions will extract actionable information for effective treatment of a variety of disorders leading to improved health outcome. These platforms provide new avenues to continuously monitor individuals, whether they are intended to detect an early onset of a disease, assess human performance or determine the effectiveness of the treatment. There are, however, a number of fundamental challenges that need to be addressed before realizing the true ubiquitous use of the wearable systems for precision medicine.

The robustness of sensing plays a key role. Human factors and wearability, as well as the ability to extract actionable information that influences the intervention are among other principal design requirements. Furthermore, understanding the contextual information surrounding the users will help the stakeholders to place the observations into perspective and take suitable actions.

In this talk, we will discuss a number of sensing and signal processing paradigms that capture physiological observations leveraging bio-impedance and optical sensing modalities. Our primary focus remains on capturing physiological observations including blood pressure, heart rate, heart rate variability and respiration rate from a “watch-like” wearable device. We will discuss several methodologies including a particle filter platform that improve the robustness of signal acquisition. We will further discuss the notion of context and leveraging IoT to augment our understanding of the surroundings of the user. We will present our experimental results and validation studies on several cohorts of human subjects and offer concluding remarks on the trends of wearable computing technology development and potential future directions to improve the health outcome.

Biography
Roozbeh Jafari is an associate professor in Biomedical Engineering, Computer Science and Engineering and Electrical and Computer Engineering at Texas A&M University. He received his PhD in Computer Science from UCLA and completed a postdoctoral fellowship at UC-Berkeley. His research interest lies in the area of wearable computer design and signal processing. His research has been funded by the NSF, NIH, DoD (TATRC), AFRL, AFOSR, DARPA, SRC and industry (Texas Instruments, Tektronix, Samsung & Telecom Italia). He has published over 160 papers in refereed journals and conferences. He has served as the general chair and technical program committee chair for several flagship conferences in the area of Wearable Computers. He is the recipient of the NSF CAREER award in 2012, IEEE Real-Time & Embedded Technology & Applications Symposium (RTAS) best paper award in 2011 and Andrew P. Sage best transactions paper award from IEEE Systems, Man and Cybernetics Society in 2014. He is an associate editor for the IEEE Transactions on Biomedical Circuits and Systems, IEEE Sensors Journal, IEEE Internet of Things Journal and IEEE Journal of Biomedical and Health Informatics. He serves on scientific panels for funding agencies frequently and is serving as a standing member of the NIH Biomedical Computing and Health Informatics study section.

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Carlo Menon, Ph.D.
Professor, Simon Fraser University

Title: An approach to mobile health

Abstract
Dr. Menon's research focuses on mobile health technologies designed to improve quality of life of individuals and reduce healthcare costs. Via a case study, this talk will present his approach to research technologies for continuous patient self-monitoring and cost-effective delivery of treatment at the point-of-care.

Biography
Dr. Menon is a Professor, Tier 1 Canada Research Chair in Biomedical Technology, in the Schools of Mechatronic Systems Engineering and Engineering Science at Simon Fraser University (SFU). Since receiving his PhD (2005) he has filed 19 groups of patents (10 issued) and published/submitted over 370 scientific works (164 journal articles) in the fields of mobile health systems and biomechatronics. He has been an Associate Editor and/or editorial board member for six journals and a reviewer for over 40 journals. He was invited to join evaluation groups for awarding scientific grants and ranking universities worldwide. Over his career, Dr. Menon has been the recipient of 30 prizes, which were awarded locally at SFU (e.g. Superior Performance in Research Award), provincially (e.g. career award from the Michael Smith Foundation for Health Research, MSFHR), nationally (e.g. career award from the Canadian Institutes of Health Research, CIHR), and internationally (e.g. Bionis Career Award). He collaborates closely with physicians and healthcare professionals at several institutions, including the GF Strong Rehabilitation Centre, the largest rehabilitation hospital in British Columbia. He has strong ties with both local and international industry, which supports his research. Dr. Menon has been nominated for the last four consecutive years for the SFU Excellence in Supervision Award – graduate students he supervised have had outstanding careers in industry (e.g. 13 currently are CEO or CTO in high-tech companies) and academia (e.g. seven are faculty members). He is dedicated to the education of undergraduate students - eight students passed their undergraduate honour thesis with "Distinction" under his supervision. Students have evaluated his teaching skills in official evaluations at 94% on average since he joined academia.

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Gari Clifford, Ph.D.
Associate Professor, Emory University and Georgia Institute of Technology,
http://gdclifford.info

Title: The elements of a successful mHealth implementation

Abstract
In this talk I'll discuss some of the design processes to successful mHealth innovation and implementation I have developed over the last 15 years. I will cover design for resource-constrained environments, user interface design, scalable implementations and financial sustainability. I'll also discuss the role and potential for artificial intelligence in medicine. Focusing on perinatal healthcare in highland Guatemala as a recent successful example, I will review these issues and highlight the cross-disciplinary team dynamics that were required.

Short Biography
Dr. Clifford received a Masters in Theoretical Physics from the University of Southampton, a DPhil in Neural Networks and Biomedical Engineering at the University of Oxford and postdoctoral research training at MIT where he later became a Principal Research Scientist, managing the development of the world's largest open access critical care database (MIMIC II). After founding the Affordable Healthcare Technologies course at MIT, and spinning out a fetal monitoring company, he moved back to Oxford to take a position as Associate Professor of Biomedical Engineering and Director of the Centre of Doctoral Training in Healthcare Innovation. At the University of Oxford he helped found the Sleep & Circadian Neuroscience Institute, and founded the Centre for Affordable Healthcare Technology, funded by ARM. In 2014 Dr. Clifford returned to the US to join Emory University and Georgia Institute of Technology where is on faculty in the joint Biomedical Engineering program and Biomedical Informatics and the Interim Chair of Biomedical Informatics. His research applies signal processing and machine learning to problems in healthcare with foci in mHealth applied to digital mental health, circadian rhythms, clinical data streams, resource-constrained environments and sleep.

Artem Dementyev
Ph.D. candidate, Massachusetts Institute of Technology

Title: Towards ubiquitous health sensing using miniature body roaming robots

Abstract
Current wearable systems are limited to static devices. This severely limits their functionality as they have limited coverage and require manual manipulation. By taking inspiration from symbiotic relationships in biology and autonomous robots, we envision *dynamic wearables technology*; robots that move on and around the human body. Freely moving on the skin or the clothing, such small robots could autonomously monitor health with unlimited spatial resolution. They can scan the body with a microscope for signs of skin cancer or pick up bioelectrical signals, such as an electrocardiogram and do acoustic sensing of the skin mechanical properties. Beyond sensing, robots can potentially do targeted therapy, such as injections and microsurgery. In other uses, the *dynamic wearable technology* could provide truly ubiquitous computing and new venues for artistic exploration of relationships between our bodies and our devices.

In this talk, I will demonstrate two complementary approaches: moving on clothing and moving on the skin. Specifically, *Rovables*, a cloth-climbing robot with magnetic wheels and *Epidermal Robots* skin-crawling robots that use suction for skin attachment. I will discuss the insights of how such robots move, adhere and navigate on the human body. Also, I will provide example applications primarily focusing on medicine, as mobile health sensors. Additionally, applications in human-computer interactions and art will be mentioned. I will also discuss how my work in novel sensor materials can provide an interesting future direction, complementary to the dynamic wearable technology.

I hope this talk will enable a new way to look at wearable devices as roaming autonomous robots akin to symbiotic insects and create a new frontier for medical wearable systems.

Short Biography
Artem Dementyev is a Ph.D. candidate in the Responsive Environments Group at the MIT Media Lab. In his research, he builds new sensor platforms. The application areas fall into many disciplines; tangible and wearable interfaces, robotics and medical applications. His research has been presented at various conferences such as CHI, UIST, and Ubicomp. He received an NSF graduate fellowship and best paper award at UIST, honorable mention awards at CHI and Ubicomp. His research has been featured in BBC, MIT Tech Review, CNN, Wired, as well as multiple other media outlets. Artem received an undergraduate degree in Bioengineering at the University of Maryland and a Master in Electrical Engineering at the University of Washington. Artem is currently with Google Research in Mountain View.

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Walter Karlen, **Ph.D.**
Assistant Professor, ETH Zurich

Title: Closing Loops with Mobile Health Systems

Abstract
Universal access to health services is a challenge across the globe due to the lack of trained medical staff, and the increasing cost of health systems. Digital health, and in particular mobile health (mHealth), leverages information and communication technologies (ICT) to decentralize and streamline health services, and facilitate access to basic diagnoses and treatments. I will present my recent research on developing and delivering a new generation of effective, sensor based mHealth solutions that are rooted in approaches from machine learning, robotics, and automation. By closing the human-machine interaction loop, we aim to overcome the essential challenges of mHealth: producing robust medical technology that can be applied reliably anywhere and anytime by medically inexperienced users to deliver reproducible and effective healthcare services and medical interventions. Our innovative results will benefit patients in low-resource and high-end medical settings alike, which I will illustrate with research projects conducted in Peru, Vietnam and Switzerland.

Short Biography
Walter Karlen is an Assistant Professor in the Department of Health Sciences and Technology, ETH Zürich, Switzerland, where he is leading the Mobile Health Systems Lab since 2014. He earned a M.Sc. degree in Micro-Engineering and a Ph.D. in Computer, Communication and Information Sciences from EPF Lausanne, Switzerland. Between 2009 and 2014, he was a post-doctoral researcher at the Electrical and Computer Engineering in Medicine research group at the University of British Columbia (UBC) in Vancouver, Canada and at the Biomedical Engineering Research Group at the University of Stellenbosch, South Africa. He is an awardee of the Rising Stars in Global Health program of Grand Challenges Canada (2012), a Killam laureate (2013), and the recipient of a Swiss National Science Foundation professorship (2014). Walter is currently co-leader of the Hochschulmedizin Zurich Flagship SleepLoop project, and manages a number of national and international research projects that aim to improve patient outcomes with intelligent medical systems.

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Oliver Amft, Ph.D.
Professor, Friedrich-Alexander Universität

Title: Personal Health Systems

Abstract
This lecture will cover novel basic and applied research to key challenges in personalised data analytics as well as hardware-software system design approaches, which I am investigating with my research group. I will show examples of our device developments, e.g. smart eyeglasses and smart garments. Furthermore, our investigations and validation studies will be covered, including extracting health- related behaviour for dietary guidance, markers of cardiorespiratory performance, for sleep and circadian rhythm, and for rehabilitation of motor function. The talk will introduce information extraction methods to – among others – derive event patterns and model personalisation strategies. Our recent advances in learning Hidden Markov Model networks will be discussed. Subsequently, I will show examples of novel marker extraction methods and fusion strategies to balance the flexibility of data models and the boundedness of expert models. Furthermore, I will introduce our systems modelling approach, comprising a hierarchical, multidomain modelling framework. Examples employing the framework will be discussed, including sensor data qualification and algorithm performance estimation. Finally, the scientific challenges that lie ahead will be discussed. I will conclude by looking at the broad opportunities for future personal health systems.

Short Biography
Oliver Amft is the founding director of the Chair of Digital Health at the Friedrich Alexander University Erlangen-Nürnberg (FAU). He received the Dipl.-Ing. (M.Sc.) from Chemnitz Technical University in 1999 and the Dr. sc. ETH (Ph.D.) from ETH Zurich in 2008, both in Electrical Engineering and Information Technology. He obtained the university teaching qualification from TU Eindhoven in 2011. Until 2004, he was a R&D project manager with ABB, Inc. Oliver Amft was an assistant professor at the Faculty of Electrical Engineering of TU Eindhoven between 2009 and 2013, tenured since 2011. In 2014, he was appointed full professor at the Faculty of Computer Science and Mathematics of University of Passau and established the Chair of Sensor Technology. In 2017, Oliver Amft was appointed full professor at FAU Erlangen-Nürnberg, Faculty of Medicine and established the Chair of Digital Health. Oliver has co-authored over 180 refereed archival scientific publications in signal processing, pattern recognition, artificial intelligence, biomedical sensors and systems, wearable computing, digital health, and embedded systems. Several of the papers received best paper awards. Oliver coordinated two European research consortia and has been a PI in several other European and national research projects. Oliver is an Editorial Board member of IEEE Pervasive Computing, co- editing the regular Wearable Computing column. He is an associate editor for several key journals in the field of biomedical health technology, including the IEEE Journal of Biomedical and Health Informatics (J-BHI), as well as in the field of ubiquitous and wearable computing, including the Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT).

Katarzyna Wac, Ph.D.
Associate Professor, University of Copenhagen, University of Geneva & Stanford Medical Center, www.qol.unige.ch and katarzynawac.org

Title: Pocket-Size Life Quality: Are We Ready for a Call?

Abstract
Patterns of diseases are changing; they relate less and less to sudden infections or crippling accidents, and on a growing scale they develop as slow and debilitating afflictions caused by repetitive harmful behaviours (e.g., poor nutrition). These behaviours relate to different domains - the physical, psychological, social and environmental - and contribute significantly to the individual's overall health and Quality of Life (QoL) in the long term. In parallel, the ubiquitous availability of personalized, miniaturized mobile and wirelessly connected technologies embedded in smartphones and wearables enable longitudinal, real-life minimally obtrusive assessments of the individual's behaviours, modelling of his/her health risks and the resulting QoL in the long term. A smartphone is eventually becoming smarter, taking the role of a personal agent of behavioural change, impacting individual lives. The QoL lab emphasizes research on overall health and life quality and it focuses on a robust, reproducible and evidence-based modelling approach based on reliable, privacy-preserving research infrastructure, leveraging a "Living Lab" approach to capture 'small personal data' acquired throughout everyday life via an individual's smartphone and wearables. The chosen modelling approach integrates a mix of theoretical components coming from computer science (pattern recognition, machine learning, deep learning, computational sensing, artificial intelligence) and theories and models from social and behavioural sciences and preventive medicine. To date, we have modelled individual's behaviours and perceptions within different QoL domains – from mobility, physical activity and public transportation usage, via sleep quality and quantity, stress, to physical safety and security. Our research also includes understanding and modelling human factors influencing the acceptance of these technologies by different stakeholders, including patients, providers, payers, policy-makers and the public. These human factors influence the collected data quality and potential of its integration into clinical workflows. Its ultimate aim is to provide behaviour and QoL models that are meaningful for the individuals and effective in achieving a sustained behaviour change, as well as can be interpreted in clinical contexts of disease prevention or diagnosis, chronic illness monitoring, treatment options or tracking the progress of rehabilitation.

Short Biography
Katarzyna Wac, PhD, is since 2015 an Associate Professor of Human-centred Computing at the Department of Computer Science (DIKU), University of Copenhagen (DK), and an Invited Professor at the University of Geneva (CH), affiliated with Stanford University and Medical Centre since 2013. She leads the Quality of Life (QoL) Technologies lab at the University of Geneva. Her research leverages new emerging mixed models at the interface between the computer and social sciences incorporating examination, diagnosis and treatment of daily life as an "organ" – much like a cardiologist examines heart - and the resulting Quality of Life as a "vital sign" - routinely reported for patients and non-patients alike. Her research appears in more than 100 peer-reviewed proceedings and journals in computer science, human-computer interaction and health informatics, and in 2018 she co-edited a book on Digital Health. She is a (co)-PI in several European (including H2020), Swiss National Science Foundation projects and Stanford Medicine projects. She contributes to the ITU European Regional Initiative for mHealth. In 2015 she was a TEDMED Research Scholar. She as well advises industry, and, as her research attracted considerable attention nationally and internationally, she is regularly interviewed in the mass media.