



**2014 Robotics: Science and  
Systems Conference Workshop**

**Advances on  
Soft Robotics**

**July 13, 2014  
University of California, Berkeley**

RSS2014 - [www.roboticsconference.org](http://www.roboticsconference.org)  
Workshop Website <http://www.robosoftca.eu/events/rss2014-workshop>



## “Advances on Soft Robotics”

The full-day **Workshop on “Advances on Soft Robotics”** at **RSS 2014** is intended to bring together experts across multiple fields in the scientific community of soft robotics. Invited talks, contribution paper talks and roundtable sessions will discuss the development of general theories, new and non-conventional approaches and techniques for most of the technologies involved in soft robotics, like smart soft materials, soft (muscle-like) actuators, soft sensors, modelling and control of soft robots, energy harvesting, design principles for soft robotics and morphological computation. Thanks to the high interdisciplinarity of the field of soft robotics the event will gather together researchers of different scientific background and potential stakeholders.

The workshop is part of the series of scientific events planned in the framework of **RoboSoft Coordination Action** (European Commission funded project under FP7-ICT-2013-C, Future and Emerging Technologies FET-Open scheme, <http://www.robosoftca.eu/>) aimed at bringing together researchers to enable the step-change in technologies and standards needed to advance soft robotics.

The workshop will contribute to the networking and collaboration activities necessary to discuss those aspect of soft robotics that are still in their exploration phase, or which have diverse roles in robotic applications, and will also explore how to test, evaluate, benchmark and communicate soft robotics technologies.

### Programme Committee



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## Programme

RSS2014 Workshop on “Advances on Soft Robotics” - July 13, 2014		
Time	Talk	Speaker
8.30 – 8.35	Opening	<b>Laura Margheri</b> , The BioRobotics Institute, Scuola Superiore Sant’Anna RoboSoft Project Management
8.35 – 8.50	RoboSoft: A Coordination Action for Soft Robotics	
<i>Invited talks</i>		
8.50 – 9.10	Soft Robotics and Integrated Soft Systems	<b>Adam Stokes</b> , Edinburgh University
9.10 – 9.30	Soft-Matter Electronics, Multifunctional Materials, and Fabrication Methods for Soft Robots	<b>Carmel Majidi</b> , Carnegie Mellon University
<i>Contribution papers</i>		
9.30 – 9.40	Shared Design Tools to Support Research and Development in Soft Robotics	<b>Conor Walsh</b> , Harvard Biodesign Lab
9.40 – 9.50	Experimental Characterization of a 2-DOF Soft Robotic Platform for Architectural Applications	<b>Bratislav Svetozarevic</b> , ETH Zurich
9.50 – 10.00	How to Create Self-Sensing Air Muscles from Conductive Fibers	<b>David Remy</b> , University of Michigan
10.00 – 10.30	- Coffee break -	
<i>Invited talks</i>		
10.30 – 10.50	Morphological computation in soft robots by using thermoplastic materials	<b>Surya G. Nurzaman</b> , ETH Zurich
10.50 – 11.10	Design, Materials, and Power Systems for Autonomous Soft Robots	<b>Mike Tolley</b> , Harvard Microrobotics Lab
11.10 – 11.30	GeckoGripper: A Soft Robotic Gripper using Gecko-Inspired Elastomer Micro-Fiber Adhesives	<b>Metin Sitti</b> , Carnegie Mellon University
11.30 – 11.50	<i>Open discussion, Q&amp;A</i>	
11.50 – 15.00	- Lunch break - Final match of the FIFA World Cup -	
<i>Invited talks</i>		
15.00 – 15.20	Bio-Inspired Smart Pneumatic Artificial Muscles with Integrated Soft Artificial Skin Sensors	<b>Yong-Lae Park</b> , Carnegie Mellon University
15.20 – 15.40	Towards soft-smart skins: a biomimetic soft robotics approach	<b>Jonathan Rossiter</b> , University of Bristol
<i>Contribution papers</i>		
15.40 – 15.50	Soft Tunable Whisker-like Sensors	<b>Pablo Valdivia y Alvarado</b> , Singapore-MIT Alliance for Research and Technology
15.50 – 16.00	Characterizing an elastomeric strain sensor at large strains and strain rates	<b>Yiğit Mengüç</b> , Harvard Microrobotics Lab
16.00 – 16.10	Structurally Compliant Orthotics	<b>Tim Swift</b> , Otherlab
<i>Invited talks</i>		
16.10 – 16.30	Softworm robots: 3D-printed crawling machines	<b>Barry Trimmer</b> , Tufts University
16.30 – 17.00	- Coffee break -	
17.00 – 17.20	Contributions of Compliance and Shape to Locomotion and Manipulation	<b>Ronald Fearing</b> , University of Berkeley
17.20 – 17.50	<i>Open discussion, Q&amp;A</i>	
17.50 – 18.00	<i>Closing remarks</i>	

## Speakers



**Laura Margheri**

**Keynote address:**

**“RoboSoft: A Coordination Action for Soft Robotics”**

Laura Margheri is Post Doc research assistant and project manager in the area of soft robotics at the BioRobotics Institute of the Scuola Superiore Sant’Anna. She has a scientific and technological background mainly in the fields of biorobotics and biomimetics, soft robotics, marine robotics, and biology. She works for the management, the organization, planning and control of R&D activities, for the reporting of activities, the coordination of the consortium, and the public dissemination of project results. She has organized several international events in robotics (project meetings, workshops and special sessions at international conferences, exhibitions, Summer Schools). She is an active member of the IEEE Robotics & Automation Society, in which she has been appointed as AdCom (Administrative Committee) Student Member and Chair of the Students Activities Committee in the 2012-2013 term. At the beginning of 2014 she has been appointed Liaison of Women In Engineering (WIE) and she represents the Robotics & Automation Society in the IEEE WIE Committee. She is also member of the Conference Activities Board and of the Members Activities Board in the society.



**Adam Stokes**

**Invited talk:**

**“Soft Robotics and Integrated Soft Systems”**

Dr Stokes is a Lecturer (Assistant Professor) in the Institute for Micro and Nano Systems (IMNS) at The University of Edinburgh; where he is the Programme Director for the MSc in Bioelectronics and Biosensors. He also teaches BEng/MEng Digital Systems Design 3 & Computer Organisation and Architecture 4. He is an interdisciplinary scientist and engineer, and a founder of The University of Edinburgh FabLab. His research interests include: robotics, physical chemistry, electrical engineering, materials science, nanotechnology, optics, proteomics, and cell biology. He holds degrees in engineering, biomedical science, and chemistry. Before joining the faculty at Edinburgh he was a Fellow in the George M. Whitesides group at Harvard University.



## **Carmel Majidi**

### **Invited talk:**

### **“Soft-Matter Electronics, Multifunctional Materials, and Fabrication Methods for Soft Robots”**

Dr. Majidi is an Assistant Professor of Mechanical Engineering at Carnegie Mellon University starting September 2011. Prior to joining the faculty, he was a postdoctoral fellow in the Harvard Microrobotics Laboratory (2009-2011) and the Princeton Institute for the Science and Technology of Materials (2007-2009). His experience in solid mechanics and microfabrication is the foundation of his current research in the emerging fields of soft robotics and active multifunctional materials.

The next generation of autonomous robots, assistive medical devices, and electronics will include systems that are soft, elastically deformable, and adapt their functionality to the changing demands of their operator and environment. Progress depends on new classes of multifunctional materials and soft machines for stretchable electronics, elastomer-based pneumatics, hyperelastic deformation sensing, and reversible shape and rigidity control.

Professor Majidi addresses these emerging challenges through a unique combination of rapid prototyping, soft-lithography microfabrication, and theoretical insights from solid mechanics. This includes innovations in liquid-embedded elastomer electronics (LE3) for stretchable sensors, circuits, and wearable computing.



## **Conor Walsh**

### **Contribution paper:**

### **“Shared Design Tools to Support Research and Development in Soft Robotics”**

Conor is Assistant Professor of Mechanical and Biomedical Engineering at the Harvard School of Engineering and Applied Sciences. He is also the founder of the Harvard Biodesign Lab, which brings together researchers from the engineering, industrial design, medical and business communities to develop smart medical devices and translate them to industrial partners in collaboration with the Wyss Institute's Advanced Technology Team. His educational interest is in the area of medical device innovation where he mentors student design teams on projects with clinicians in Boston and in emerging regions such as India. Conor received his B.A.I and B.A. degrees in Mechanical and Manufacturing engineering from Trinity College in Dublin, Ireland, in 2003, and M.S. and Ph.D. degrees in Mechanical Engineering from the Massachusetts Institute of Technology in 2006 and 2010. He has been the recipient of over a dozen invention, entrepreneurship, and student mentoring awards including the MIT \$100K business plan competition, Whitaker Health Sciences Fund Fellowship, and the MIT Graduate Student Mentor of the Year.





### **Bratislav Svetozarevic**

#### **Contribution paper:**

#### **“Experimental Characterization of a 2-DOF Soft Robotic Platform for Architectural Applications”**

Bratislav Svetozarevic is a PhD student at the Institute of Technology in Architecture at ETH Zurich within the Architecture & Sustainable Building Technologies (SuAT) group of Prof. Arno Schlüter. He holds a Dipl. –Ing. in Electrical Engineering with honors (2008) with major in Automatic Control and a MSc in Electrical Engineering and Computer Science (2010) with focus on humanoid-robotics both from University of Belgrade. He was a research assistant at the Institute of Automatic Control (2010-2012) at ETH Zurich working on control and optimization methods in power systems (optimal generation capacity expansion in liberalized markets and fault detection and isolation for wind turbines). In 2013 he worked as a R&D engineer at the spin-off company Enexra Tools GmbH / Siltecta GmbH on the Semi-automatic robotic system for kerf-free silicon wafer production. He joined SuAT in 2014 as a PhD student to work on soft robotics actuators for the Adaptive Solar Façade and on control strategies for the Adaptive Systems Lab (ASL). His research interests are in the development and control of complex systems.



### **David Remy**

#### **Contribution paper:**

#### **“How to Create Self-Sensing Air Muscles from Conductive Fibers”**

C. David Remy, Assistant Professor, Department of Mechanical Engineering, University of Michigan.

Prof. Remy's research interests include the design, simulation, and control of legged robots, exoskeletons, and other nonlinear systems. Drawing inspiration from biology and biomechanics, he is particularly interested in the effect and exploitation of natural dynamic motions, the role of different gaits, and the possibility of force/torque controllable systems; both in conceptual models and in hardware realizations.

<http://ram-lab.engin.umich.edu/>



## **Surya G. Nurzaman**

### **Invited talk:**

### **“Morphological computation in soft robots by using thermoplastic materials”**

Surya G. Nurzaman is a postdoctoral research fellow and deputy manager of the bio-inspired robotics laboratory, ETH Zürich, Switzerland. He obtained his PhD from Osaka University, Japan, in 2011, with the support of the Monbukagakusho scholarship. Before coming to Japan, he finished his Bachelor and Master degrees at Institute of Technology Bandung, Indonesia and worked as a technology consultant at Accenture. His research interests include bio-inspired robotics, soft robotics, dynamical systems and morphological computation. He is also an organizer of the IEEE TC on Soft Robotics, and a working member of the EU FP7 Myrobotics project and Robosoft Coordination Action



## **Mike T. Tolley**

### **Invited talk:**

### **“Design, Materials, and Power Systems for Autonomous Soft Robots”**

Michael T. Tolley is a Research Associate with the Harvard Microrobotics Lab and the Wyss Institute for Biologically Inspired Engineering at Harvard University. He received the B. Eng. degree (with honors) in mechanical engineering from McGill University, Montreal, QC, Canada, in 2005 and the M. S. and Ph.D. degrees in mechanical engineering with a minor in computer science from Cornell University, Ithaca, NY, USA in 2009 and 2011, respectively. In 2015, he will be joining the Department of Mechanical and Aerospace Engineering at the University of California, San Diego as an Assistant Professor. His current research interests include biologically inspired robotics, origami-inspired fabrication, self-assembly by folding, and mobile soft robotics.



## Metin Sitti

### Invited talk:

### **“GeckoGripper: A Soft Robotic Gripper using Gecko-Inspired Elastomer Micro-Fiber Adhesives”**

Metin Sitti received the BSc and MSc degrees in electrical and electronics engineering from Bogazici University, Istanbul, Turkey, in 1992 and 1994, respectively, and the PhD degree in electrical engineering from the University of Tokyo, Tokyo, Japan, in 1999. He was a research scientist at UC Berkeley during 1999-2002. He is currently a director in Max-Planck Institute for Intelligent Systems and a professor in Department of Mechanical Engineering and Robotics Institute at Carnegie Mellon University. His research interests include physical intelligence, mobile micro-robots, novel micro/nano-materials, bio-inspired milli-robots, soft robotics, and micro/nano-manipulation. He is an IEEE Fellow. He received the IBM Smarter Planet Award in 2012, the SPIE Nanoengineering Pioneer Award in 2011, and NSF CAREER Award in 2005. He received the IEEE/ASME Best Mechatronics Paper Award in 2014, the Best Poster Award in the Adhesion Conference in 2014, the Best Paper Award in the IEEE/RSJ International Conference on Intelligent Robots and Systems in 2009 and 1998, the first prize in the World RoboCup Micro-Robotics Competition in 2012 and 2013, the Best Biomimetics Paper Award in the IEEE Robotics and Biomimetics Conference in 2004, and the Best Video Award in the IEEE Robotics and Automation Conference in 2002. He is the editor-in-chief of Journal of Micro-Bio Robotics.



## Yong-Lae Park

### Invited talk:

### **“Bio-Inspired Smart Pneumatic Artificial Muscles with Integrated Soft Artificial Skin Sensors”**

Yong-Lae Park is an Assistant Professor in the Robotics Institute, the School of Computer Science, and the Department of Mechanical Engineering at Carnegie Mellon University. Prior to joining Carnegie Mellon in 2013, Prof. Park completed his Ph.D. degree in Mechanical Engineering from Stanford University, in 2010, and conducted postdoctoral research in the School of Engineering and Applied Sciences and the Wyss Institute for Biologically Inspired Engineering at Harvard University. His research focuses on bio-inspired design and manufacturing of soft robots and microrobots. He is the winner of a Best Paper Award from the IEEE Sensors Journal, a NASA Tech Brief Award from the NASA Johnson Space Center, and a Technology Development Fellowship from the Wyss Institute at Harvard University. His paper on soft artificial skin was selected as a cover article of the IEEE Sensors Journal, and his work on soft wearable robots was recently featured in Discovery News and New Scientist.





## **Jonathan Rossiter**

### **Invited talk:**

### **“Towards soft-smart skins: a biomimetic soft robotics approach”**

Jonathan Rossiter is Reader in Robotics at the University of Bristol and head of the Soft Robotics group at Bristol Robotics laboratory. He is co-organiser of the RoboSoft coordination action in Soft Robotics, editorial board member for the Soft Robotics journal and programme committee member for international smart materials and robotics conferences. He has managed and delivered on projected funded by sources including EPSRC, BBSRC, FP7, H2020, Royal Society and the Leverhulme Trust, and has published over 100 peer reviewed articles. Jonathan Rossiter specialises in the development and exploitation of smart materials, artificial muscles, compliant systems and human-machine physical interaction.



## **Pablo Valdivia y Alvarado**

### **Contribution paper:**

### **“Soft Tunable Whisker-like Sensors”**

Pablo Valdivia y Alvarado obtained his B.S., M.S., and Ph.D. degrees in Mechanical Engineering at the Massachusetts Institute of Technology. Dr. Valdivia y Alvarado is a Research Scientist in the Center for Environmental Sensing and Modeling at the Singapore-MIT Alliance for Research and Technology. His research lies at the intersection of Robotics, Design, and Modeling. Dr. Valdivia y Alvarado was recognized with a TR35 young innovator award for South East Asia, Australia and New Zealand in 2012 for his work on soft robots for harsh environments. His doctoral work on the design of bio-inspired soft-robots received a considerable amount of publicity worldwide with articles appearing in CNN, the Discovery Channel, National Geographic, and Wired Magazine among others.



## **Yiğit Mengüç**

### **Contribution paper:**

**“Characterizing an elastomeric strain sensor at large strains and strain rates”**

Yiğit Mengüç is postdoctoral fellow at the Harvard MicroRobotics Lab. He is a mechanical engineer, an instrument-maker, and an experimentalist. Using biological inspiration, he designs mechanisms that are as soft as skin and muscle, then manufacture them with techniques in 3D printing, laser machining, and soft lithography. Two classes of instruments that he has invented so far are controllable gecko-inspired adhesives and soft wearable sensors. The design and manufacture of soft devices that extend our technical capabilities has been the goal in his brief time in the engineering community. The last five decades have seen rigid robots dominate factories, but the future will be characterized by robotic devices that are physically compliant, exceptionally dynamic, and ever-present in our daily lives. This is the engineering tradition of which he is part: the material revolution of biologically inspired and soft robotics.



## **Tim Swift**

### **Contribution paper:**

**“Structurally compliant orthotics”**

Tim Swift received his MS ('09) and PhD ('11) from UC Berkeley and leads the research into inflatable robotics at Otherlab. His team is using novel fabric actuators to create lightweight, low cost assistive orthotics and robotic manipulators. Previously, he was an early employee at Ekso Bionics where he was the original controls technical lead and a lead inventor of their rehabilitation exoskeleton Ekso. He later oversaw the Ekso Bionics research group, which was a team of 10-15 engineers advancing the control and design of exoskeletons and other mobile robotics.



## Barry Trimmer

### Invited talk:

### **"Softworm robots: 3D-printed crawling machines"**

Barry Trimmer is the *Henry Bromfield Pearson Professor of Natural Science* and holds secondary appointments in Biomedical Engineering and in Neuroscience at the Tufts Medical School. He received both his undergraduate and PhD degrees from the University of Cambridge in England and carried out post doctoral training in Neuroscience at Harvard Medical School with Professor Edward Kravitz and at the University of California, Berkeley and the University of Oregon, Eugene with Professor Janis Weeks. His research focus is on the Neuromechanics of Locomotion. In addition to his work on living systems, Professor Trimmer is Director of the Tufts Neuromechanics and Biomimetic Devices Laboratory which specializes in the application of found biological principles to the design and fabrication of soft robots. Dr. Trimmer is also Director of the NSF-funded Integrative Graduate Education and Research Training (IGERT) program in *Soft Material Robotics* and Editor in Chief of the journal *Soft Robotics*. These interests converge in his recent research that seeks to "grow" robotic devices using a combination of biosynthetic materials, cellular modulation, and tissue engineering. These Biosynthetic Robots will be versatile, safe, biocompatible, and biodegradable.



## Ronald Fearing

### Invited talk:

### **"Contributions of Compliance and Shape to Locomotion and Manipulation"**

Ronald Fearing is a professor in the Dept. of Electrical Engineering and Computer Sciences at Univ. of California, Berkeley, which he joined in Jan. 1988. He was Vice-Chair for Undergraduate Matters from 2000-2006. His current research interests are in milli-robotics, including flying and crawling milli-robots, parallel nano-grasping (gecko adhesion), micro-assembly, and rapid prototyping. He has worked in tactile sensing, teletaction, and dextrous manipulation. He has a PhD from Stanford in EE (1988) and SB and SM in EECS from MIT (1983). He received the Presidential Young Investigator Award in 1991, and is the co-inventor on 16 US and international patents.



**A Coordination Action for Soft Robotics**  
**European Commission Future and Emerging Technologies -**  
**FET- Open Scheme (FP7-ICT-2013-C project # 619319)**

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