

2012 ICRA Workshop “Bio-Bots”

Abstract

There will be a FULL DAY WORKSHOP entitled, “Bio-Bots: Biological Robots Having Live Cells and Microbes as Components of a Robot” at this year’s IEEE International Conference on Robotics and Automation (ICRA).

Following the first successful workshop at the 2011 ICRA, we would like to extend the Bio-Bots workshop for the 2012 ICRA with a renewed scope. Our shared view in this workshop is that breakthroughs in bio-artificial muscles, biosensors, and synthetic biology are providing components usable for building biological robots. Bacteria-propelled micro-nano robots have already been built, having significant impacts upon medicine and biology. Technologies for culturing cells and tissues to produce novel sensors, actuators, and processors have also been developed, which can be integrated into micro-nano robots for advanced applications. The boundary between biology and robotics is being fused in this emerging field. The objective of this workshop is to display the state-of-the-art of Bio-Bots, discuss key technologies and challenges, and address system-level issues, applications, and opportunities. We will also address educational issues: how we can best educate students who will work in the field where engineering and biology are seamlessly integrated. Nine speakers from the robotics community have already been confirmed. A few more speakers from synthetic biology and tissue engineering will be invited to promote cross-disciplinary communications.

Organizer: H. Harry Asada
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Presenters:

H. Harry Asada	M.I.T.	Confirmed
Paolo Dario	Scuola Superiore Sant’Anna and Italian Institute of Technology	Confirmed
Vijay Kumar	University of Pennsylvania	Confirmed
Toshio Fukuda	Nagoya University	Confirmed
Metin Sitti	Carnegie Mellon University	Confirmed
Sylvaine Martel	Polytechnique of Montreal	Confirmed
Joel Burdick	California Institute of Technology	Confirmed
Koji Ikuta	University of Tokyo	Confirmed
Arianna Menciassi	Scuola Superiore Sant’Anna	Confirmed
Rashid Bashir	University of Illinois at Urbana-Champaign	

List of Topics:

- a) Harvesting microbes, bacteria and insects for micro-robot actuation;
- b) Culturing cells and tissues for robotic components;
- c) Micro-nano technology for assembling and manipulating biological components;
- d) Integrating/interfacing biological components with engineering components;
- e) Scalability of the bio-hybrid approach;
- f) Applications to surgical tools, medical intervention, rehabilitation, and non-medical applications; and
- g) Bio-robotics education

Motivation and Objectives (Justification):

Biologically-inspired robots and bio-mimetics have been popular topics in robotics and other scientific fields for the past decade. Scientists and engineers have mimicked and physically realized the functionality of animals by using traditional robot components. In that paradigm biology is a metaphor of useful functionality, providing insights into how advanced functionality and salient features can be attained. In turn robotics provides implementation tools and actual physical models. In Bio-Bots, this traditional biology-robotics boundary is fused or removed by exploiting superb functionality of live cells and microbes and integrating them as components for building a robot. This is clearly a paradigm shift from merely mimicking functionality to exploitation, processing, and integration of live biological systems, and as such the role of robotics is to be changed. In this early stage of technology development, Bio-Bots are facing a number of technical challenges. Properly interfacing biological components with engineering components, for example, is a critical issue. Biology and biological engineering alone cannot solve the problem; effective solutions can be brought in from engineering and robotics. In turn, robotics will be one of the main beneficiaries of bio-bots. Bio-bots will not only bring about novel components and cutting-edge tools for building robots, but will also open up a whole new arena of robot mechanics, control, and design. Bio-artificial muscles, for example, have entirely different properties and functionality than those of DC/AC motors with gears. Biosensors and neural processing, too, are strikingly different characteristics than their traditional counterparts.

The overarching objective of this workshop is to put in perspective the diverse research activities in the broad cross-disciplinary areas of robotics, cell biology, neuroscience, and control, and explore new methodologies and applications from a broad system viewpoint. This aligns with the theme of the 2012 ICRA conference: Innovations for Tomorrow's Needs.

Primary / Secondary Audience

We expect that this workshop will attract many researchers, students, and practitioners from various topics areas. We expect to have audience of diverse expertise and interests. These areas include:

Primary

- Micro-nano robots
- Biological robots
- Neuro-robotics
- Bio-sensors
- Robotics devices using bacteria and insects.

Secondary

- Bio-inspired robots and bio-mimetics
- Novel actuators
- Brain-computer interface; Human-robot interface

The Mico-Nano Robotics and Automation Technical Committee supports this workshop.