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Introduction

This SPIE's Electroactive Polymers Actuators and Devices (EAPAD) Conference is the leading international forum for presenting the latest progress and holding discussions among the attendees regarding the capabilities, challenges and potential future directions. The conference this year was co-chaired by Jinsong Leng, Harbin Institute of Technology (China) and included 120 presentations, which is the largest number of EAP-related papers that have ever been submitted. EAP materials are increasingly attracting researchers from many fields for their large displacement and functional similarity to biological muscles.

The Conference was well attended by leading world experts in the field including members of academia, industry, and government agencies from the USA and overseas. The Keynote speaker was Bharat Bhushan of The Ohio State Univ, and the title of his presentation was "Biomimetics: lessons from nature". In his presentation, he gave a broad overview of various objects and processes of interest found in nature and applications under development or available in the marketplace. He focused on the recent research on superhydrophobicity, self-cleaning, low adhesion/stiction, and highlighted drag reduction in fluid flow.

Turning EAP into actuators-of-choice requires solidifying the technical foundations and identifying niche applications taking advantage of their unique capabilities to provide edge for critical needs. Significant progress was reported in each of the topics of the EAP infrastructure. The papers focused on issues that can forge the transition to practical use, including improved materials, better understanding of the principles responsible for the electromechanical behavior, analytical modeling, processing and characterization methods, as well as considerations and demonstrations of various applications. Two special sessions were dedicated this year to the topic of haptic interfaces and refreshable Braille displays and they were chaired by Qibing Pei, Univ. of California, Los Angeles; Deane B. Blazie, National Braille Press as well as Federico Carpi, Univ. di Pisa (Italy); Noel H. Runyan, National Braille Press. Other topics that were covered in this conference included:

- Electroactive polymers (EAP) and non-electro active-polymer (NEAP) materials
- Theoretical models, analysis and simulation of EAP
- Methods of testing and characterization of EAP
- EAP as artificial muscles, actuators and sensors
- Design, control, intelligence, and kinematic issues related to robotic and biomimetic operation of EAP
- Under consideration and in progress applications of EAP

The efforts described in the presented papers are showing significant improvements in understanding of the electromechanical principles and better methods of dealing with the challenges to the materials applications. Researchers are continuing to develop analytical tools and theoretical models to describe the electro-chemical and -mechanical processes, non-linear behavior as well as methodologies of design and control of the activated materials. EAP with improved response were described including dielectric elastomer, electrostrictive, IPMC, carbon nanotubes, conductive polymers, and other types. Specifically, there seems to be a significant trend in towards use of dielectric elastomers as practical EAP actuators.

This year, the EAP-in-Action Session was held on Monday, March 8, 2009 and it included eight demonstrations from Harbin Institute of Technology (China); Danfoss PolyPower A/S (Denmark); Univ. of Pisa, Research Centre "E. Piaggio" (Italy); The Auckland Bioengineering Institute's Biomimetics Lab. (New Zealand); Artificial Muscle, Inc. (AMI) (United States); National Braille Press (United States); Ras Labs. LLC (United States); Univ. of California, Los Angeles (United States); iRobot G&I Research (United States).

To provide the attendees with opportunity to learn about EAP, an introductory course was given on Sunday, March 7, 2009 as part of the EAPAD Conference. The course was entitled "Electroactive Polymer Actuators and Devices," and the lead instructor was the Conf. Chair, Yoseph Bar-Cohen, who presented an overview, and covered applications that are currently developed and ones that are being considered. The subject of ionic EAP was covered by John D. W. Madden, the Univ. of British Columbia, Canada, while the topic of electronic EAP was covered by Qibing Pei from the University of California at Los Angeles (UCLA). For those who are seeking to self-learn about EAP, a comprehensive coverage of the topic is given in the 2nd Edition of the book that was published by SPIE Press entitled "Electroactive Polymers (EAP) actuators as artificial muscles" [http://ndeaa.jpl.nasa.gov/nasa-nde/yosi/yosi-books.htm], as well as the WW-EAP webhub: [http://eap.jpl.nasa.gov] with links to the leading research and development labs worldwide, and the WW-EAP Newsletter.

In closing, we would like to extend a special thanks to all the conference attendees, session chairs, the EAP-in-Action demo presenters, the members of the EAPAD program organization committee. In addition, special thanks are extended to the SPIE staff that helped making this conference a great success.

Yoseph Bar-Cohen