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Introduction

The large displacement actuation that can be produced by EAP materials and their functional similarity to biological muscles are increasingly attracting the interest of researchers from many fields. Turning these materials into actuators-of-choice continues to require solidifying the technical foundations and identifying niche applications where their unique capabilities would provide edge for critical need(s). This SPIE Electroactive Polymers Actuators and Devices (EAPAD) Conference serves as the leading international forum for presenting the latest progress and discussions among the attendees regarding capabilities, challenges, and potential future directions.

The keynote speaker was George V. Lauder, Harvard University, and the title of his presentation was "How fish swim: flexible fin thrusters as an EAP platform." This presentation gave the attendee details about the swimming mechanism of fish as well as the needs for making robotic fish using EAP. This paper tied well with the EAP-in-Action session this year where a blimp was demonstrated to be steered by dielectric elastomer EAP strips on its four fins. This blimp is currently under redesign by EMPA, Switzerland, towards propelling it in the air by tail-wagging, like fish. This EAP-in-Action Session was held on Monday, March 19, 2007, and it included six demos by organizations from Italy, Japan, Switzerland, and the USA. The company Artificial Muscle, Inc. presented the first high-volume standard commercial EAP product. Other demos in this session included speaker, power generator, active display, lens positioner, proportional valve, and others. The presenters included Artificial Muscle, Inc.; Hyper Drive Corporation; Materials Science & Technology; Empa; Research Centre "E. Piaggio"; University of Pisa; Ras Labs; and SRI International.

The conference this year included 80 presentations and was well attended by leading world experts in the field, including members of academia, industry, and government agencies from the USA and overseas. 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. Papers in this conference covered the following topics:

- Electroactive polymers (EAP) and non-electroactive polymer (NEAP) materials
- Theoretical models, analysis, and simulation of EAP and computational chemistry
- Support technologies, including electroding, synthesis, processing, shaping, and fabrication
- Methods of testing and characterization of EAP
- EAP as multifunctional materials
- EAP scalability to miniature (MEMS, micro and nano) and large dimensions
- EAP as artificial muscles, actuators, and sensors

- Design, control, intelligence, and kinematic issues related to robotic and biomimetic operation of EAP
- Applications of EAP under consideration and in progress.

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, nonlinear behavior, as well as methodologies of design and control of the activated materials. EAP with improved response were described including electrostrictive, IPMC, dielectric, carbon nanotubes, conductive polymers, and other types.

To provide the attendees with an opportunity to learn about EAP, an introductory course was given on Sunday, March 18, 2007, as part of the EAPAD conference. The course was entitled "Electroactive Polymer Actuators and Devices," and the lead instructor was Conference Chair Y. 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 J. Madden from the University of British Columbia, Vancouver, Canada. Further, the topic of electronic EAP was covered by Q. Pei from the University of California at Los Angeles (UCLA). This course was intended for engineers, scientists, and managers who need to understand the basic concepts of EAP, or are interested in learning, applying, or engineering mechanisms or devices using EAP materials. Also, it was intended for those who are considering research and development in EAP materials and their present and/or future applications. For those who are seeking to self-learn about EAP, a comprehensive coverage of the topic is given in the second 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, I 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, and my cochair, Gabor Kovacs, Empa, Switzerland. In addition, special thanks are extended to the SPIE staff who helped in making this conference a great success.

Yoseph Bar-Cohen