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KEYNOTE PRESENTATION

Biomimetic Robots using EAP as Artificial Muscles – Progress and Challenges

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Biology offers a great model for emulation in areas ranging from powerful tools, superb computational algorithms, materials science, mechanisms and information technology. In recent years, the field of biomimetics, namely biology mimicking, has blossomed with significant advances enabling to reverse engineer many animals' functions and system characteristics, and to technologically implement these capabilities. Some of the implementations of this progress can be seen at many toy stores, where toys appear and behave like living creatures including dogs, cats, birds, frogs and others. Other benefits of this technology include prosthetic implants and human aiding mechanisms that may be interfaced with the human brain to assist in hearing or seeing. Technology evolution led to such fields as artificial intelligence and artificial muscles, which allow the consideration of making more realistic biomimetic intelligent robots. Actuation via polymers that exhibit large displacement in response to other than electrical signal (e.g., chemical, thermal and light) were known for many years. Initially, electroactive polymers (EAP) received a relatively little attention due to their limited actuation capability. However, in the last fifteen years, the view of the EAP materials has changed due to the introduction of effective new materials that surpassed the capability of the widely used piezoelectric polymer, PVDF. Currently, efforts are underway to address the many challenges that are hampering the practical application of these materials. Various novel mechanisms and devices were already demonstrated including catheter steering element, robotic arm, gripper, loudspeaker, active diaphragm, and dust-wiper. Other applications that are currently being considered include active Braille display for blind people and electroactive clothing, e.g., smart-bra with battery driven shape control.

In recognition of the need for cooperation in this multidisciplinary field, the author initiated and organized a series of international forums that include annual SPIE conferences, the WW-EAP Newsletter and webhub, edited a comprehensive book on this subject and is continuing to take helping initiatives. In 1999, he challenged the worldwide science and engineering community of EAP experts to develop a robotic arm that is actuated by artificial muscles to win an arm wrestling match against a human opponent. Progress towards this goal will lead to significant benefits, particularly in the medical area, including effective prosthetics. In this paper, the field of EAP as artificial muscles will be reviewed covering the state of the art, the challenges and the vision for the progress in future years.