

# **EAP as Artificial Muscles –Progress and Challenges**

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Polymers have many attractive characteristics; they are lightweight, inexpensive, and fracture tolerant. Further, they can be configured into almost any conceivable shape and their properties can be tailored to suit a broad range of requirements. During the last fourteen years new polymers have emerged that respond to electrical stimulation with a significant shape or size change, and this progress has added an important capability to these materials. This capability of the electroactive polymer (EAP) materials is attracting the attention of engineers and scientists from many different disciplines. Since they behave very similar to biological muscles, EAPs have acquired the moniker “artificial muscles.” Practitioners in biomimetics (a field where robotic mechanisms are developed based on biologically inspired models) are particularly excited about these materials since the artificial muscle aspect of EAPs can be applied to mimic the movements of animals and insects. In the foreseeable future, robotic mechanisms actuated by EAP will enable engineers to create devices previously imaginable only in science fiction. One such commercial product has already emerged in Dec. 2002 is a form of a Fish-Robot (Eamex, Japan). It swims without batteries or a motor and it uses IPMC fins that simply bend upon electrical stimulation. This fish represents a major milestone for field - it is the first reported commercial product that uses electroactive polymers. Another major milestone is a statement from scientists from SRI International claiming that they believe to be ready to develop the first robotic hand that has the potential to win an arm-wrestling match against a human opponent. While this is only a statement, still, reaching the level that such a professional self-assessment can be made about EAP related to robotic capability is an important milestone. As such major accomplishments continue to be reported it is interesting to review the progress and provide a prospective regarding the development since the first EAPAD conference in 1999. This paper will cover the progress in the field of EAP and the challenges that are being addressed.

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