Smart materials for biomimetic kinestetic-like sensing and pseudo muscular actuation

Danilo De Rossi
University of Pisa

January 23, 2005 at 15:00

The seminar addresses the design and development of biomimetic systems based on smart polymers potentially useful in the design and implementation of humanoid robots. This talk is divided into two separate parts which are treated independently although their use in the robotic systems should necessarily pass trough their integrated design;

Abstract 1: Polymer based biomimetic actuators as artificial muscle.

This talk will provide a short survey on the state-of-the-art technologies of polymer actuation currently studied to develop smart active devices and to pursue the ambitious aim of implementing future 'artificial muscles'. In particular, devices based on electroactive polymers will be presented and discussed in the light of several applications currently under development.
A particular emphasis will be devoted to the distinction between low-voltage and high-voltage technologies, characterised by different performances and enabling different types of uses.

See next page for abstract of second part

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Abstract 2: Kinestetic kinestetic-like sensing for gesture and posture recognition and classification.

The fabrication of electronic systems onto substrates which are not only flexible, but also conformable to the human body, represents a breakthrough in many areas of application, such as virtual reality, teleoperation, telepresence, ergonomics, and rehabilitation engineering. The possibility of realizing sensing textiles by coating traditional fabrics with smart materials (piezoresistive, piezoelectric, and piezocapacitive polymers) is quite recent and has opened up a means of implementing a new type of man-machine interface technology. Peculiar features that require the application of new processing approaches have then emerged. Having a set of sensors distributed on a garment poses a certain number of new problems, amongst which is the need for minimizing the wiring required to extract the signals from every single sensor. Second, given the variability between individuals, the sensors on a garment cannot, in general, always be positioned exactly at the same location; therefore, the repeatability of measurements is not guaranteed on the same subject, and it becomes entirely different going from one subject to another. An even more demanding requirement resides in the need for a high immunity to motion artifacts and for provisions to deal with the sensors crosstalk. A basic point made here is based on the observation that a redundant number of sensors distributed on a surface can provide enough positional information to infer the essential features concerning the posture of a subject, also loosening the constraint of precise sensor location. This approach borrows from the biological paradigm. For instance, as far as mechanoreception is concerned, high-quality biological sensors are not used everywhere, particularly if they are sufficiently numerous. On the other hand, reading singularly a very numerous set of sensors can be time consuming and it requires a noticeable amount of wiring, unless suitable strategies are adopted. In this paper, we illustrate the techniques which enable the realization and utilization of wearable sensing garments capable of recording proprioceptive maps with no discomfort for the subject and negligible motion artifacts caused by sensor-body mechanical mismatch.

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