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Development of self-sensing systems comprising polymeric artificial muscles

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Skeleton muscles and tendons are able to sense their relative position and the required force while they contract and expand via specific organs. Actuation and sensing occur at the same time. Similar abilities were discovered for electroactive materials based on conducting polymers which sense temperature, electrolyte concentration, and trailed mass while moving[1–3]. Dual sensing-actuating artificial muscles based on these materials driven by electrochemical reactions announce the development of self-sensing devices. Several sensors and a faradaic motor work simultaneously in one uniform device driven by the reaction of the constitutive material, like skeleton muscles do[4]. The integration of dual sensing artificial muscles into devices could reduce the complexity, the size and the control effort of nowadays technology.

The aim of the project is the investigation of novel materials for dual sensing-actuating artificial muscles and the development of a proof of concept for industrial applications. Electroactive materials are synthesized and characterized, in particular basic conducting polymers such as polypyrrole and its composites with reasonable life time, reproducibility and stability. With these electroactive materials, dual sensing-actuating artificial muscles are fabricated and tested under different experimental conditions. Furthermore, novel configurations of these motors are designed and tested. Based on the experimental results theoretical descriptions are derived, characteristic material values are determined and the existing proprioceptive model[1–3] is adopted in terms of real world environment. In the second phase of the project a functional demonstrator is developed and fabricated as a proof of concept. Based on the updated proprioceptive model and the application requirements a control system for self-sensing systems is developed and the demonstrator is designed. The demonstrator will show the potential of dual sensing-actuating polymeric artificial muscles for future technology.

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References:

[1] Martinez, J. G.., Otero, T. F., "Biomimetic dual sensing-actuators: theoretical description. Sensing electrolyte concentration and driving current," J. Phys. Chem. B **116**(30), 9223–9230 (2012).

[2] Otero, T. F., Sanchez, J. J.., Martinez, J. G., "Biomimetic dual sensing-actuators based on conducting polymers. Galvanostatic theoretical model for actuators sensing temperature," J. Phys. Chem. B **116**(17), 5279–5290 (2012).

[3] Martinez, J. G.., Otero, T. F., "Mechanical awareness from sensing artificial muscles: Experiments and modeling," Sens. Actuators B Chem. **195**, 365–372 (2014).

[4] Otero, T. F., "Biomimetic conducting polymers: synthesis, materials, properties, functions, and devices," Polym. Rev. **53**(3), 311–351 (2013).