Robotic Application of multi-DOF IPMC based on Pattering

Toshiharu Mukai^a, Boyko Stoimenov^a, Jonathan Rossiter^{a,b}, Norihiro Kamamichi^{a,c}, Yoshihiro Nakabo^{a,d}

^aBio-Mimetic Control Research Center, RIKEN, Nagoya, Japan, tosh@bmc.riken.jp ^bDepartment of Engineering Mathematics, University of Bristol, Bristol, UK. ^cDepartment of Robots and Mechatronics, Tokyo Denki University, Tokyo, Japan ^dIntelligent Systems Institute, AIST, Tsukuba, Japan

An ionic polymer-metal composite (IPMC) strip is a high polymer gel film whose surfaces on both sides are plated with gold as electrodes. It bends when a voltage is applied between the electrodes and is sometimes called an artificial muscle. It is a lightweight soft actuator and can also be used as a soft sensor. By applying IPMC to robotics, we can develop new kinds of robot that are completely different from those made of electromagnetic motors and semiconductor sensors.

To this end, we have developed a patterning method to give multiple degrees of freedom (DOF) to a strip of IPMC by segmenting electrodes on the surface of the IPMC, which allows us to control each segment individually. Using this method, we are developing simple and flexible actuator units, sensing units, and robots. In this presentation, we reports our recent results including a totally flexible snake-like swimming robot, a bistable artificial muscle actuator that can keep a stable structure when power is removed because of buckled bistable beam structure, and a trial to use a strip of IPMC as an actuator and a sensor simultaneously.