Modeling, Fabrication and Control of Micro Bio-Syncretic Robots based on Living Beating Cells

Lianqing Liu¹,*, Chuang Zhang¹², Wenxue Wang¹, Ning Xi³, Yuechao Wang¹
¹ State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang, 110016, China.
² University of Chinese Academy of Sciences, Beijing, 100049, China.
³ Emerging Technologies Institute, Department of Industrial & Manufacturing Systems Engineering, University of Hong Kong Pokfulam, Hong Kong.
* The author is the corresponding author. E-mail: lqliu@sia.cn

Abstract
Bio-syncretic robots, which are composed of living biological systems and artificial electromechanical systems, have attracted considerable attention for their potential performance. This kinds of robots may offer both the advantages of living organisms, such as high energy conversion efficiency, high energy density, biocompatibility and potential self-repair, and qualities of electromechanical devices, including high accuracy, high strength, and favorable repeatability. Although many current works about bio-syncretic robots have demonstrated the feasibility of the combination of bio-actuators with soft materials, most of them only focus on the realization of the bio-actuated devices, and lack of quantitative study of the bio-syncretic robots. For example, for living cells based actuation, there are few of theoretical model to describe the actuation mechanism of the beating cells constituting the bio-syncretic robots at micro-scale. And few of them has implemented the detailed study on the stimulus-response of living cells related to the control of bio-syncretic robots. In this topic, a theoretical model of a single muscle cell at the sub-cellular scale for the actuation and control of bio-syncretic robots will be introduced. And the fabrication, measurement and control methods of micro bio-syncretic robots will be discussed. Finally, a controllable biomimetic micro bio-syncretic crawler based on living beating cells will be demonstrate.