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Development of a micro-biorobot for drug delivery: Bacterial propulsion of liposomes

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Abstract

The primary goals of biomedical micro-robots is to reach currently inaccessible areas of the human body and carry out a host of complex operations. Potential targeted medical applications for these micro-robots include highly localized minimally invasive surgery, drug delivery, and screening for diseases at their early stages. However, two of the most significant obstacles are the miniaturization of the on-board actuators and power sources required for mobility and realization of high-mobility delivery vehicles. Bio-motors are deemed to be one of the most promising choices for on-board actuation. They have many advantages over man-made actuators mainly because they are much smaller and are capable of producing more complicated motions. More importantly, they convert chemical energy to mechanical energy very efficiently. Liposome as drug delivery vehicle can contain biologically active compounds. If required chemicals can be injected into the liposome and efficiently transported to a local area in human body, there will be a potential of applying them to drug delivery system. Biological micro-robot is a good choice for transporting the liposome. To address these problems for micro-robots and drug delivery vehicle, we propose miniature, and energy-efficient bio-mimetic propulsion concepts of interfacing bacteria with liposome by means of antibody, with the ultimate goal of using bacteria with liposome for actuation, control, sensing, and moving towards target. The research work presented here intends to investigate the stochastic nature of bacterial propulsion of liposome, which is important for developing next-generation bio-hybrid swimming micro-robots finding applications in diverse fields ranging from biomedical to environmental applications.

Biography

Zhenhai Zhang is an associate Professor in the School of Mechatronics Engineering at the Beijing Institute of Technology (BIT), China. From 2010 to 2011, he is a postdoctoral researcher in Department of Micro-Nano Systems Engineering, Nagoya University, Japan. He received his M.S. and Ph.D. degrees in the School of Mechatronics Engineering from BIT in 2004 and 2008, and his B.S. degree from Harbin University of Science & Technology (HUST), Harbin, China in 1997, respectively. His main research interests include Bio-micro Manipulation System and Bio-MEMS, MEMS/NEMS sensors and test technology. He is Council Member of Sensor Branch of China Instrument and Control Society, Committee Member of Optoelectronic Technology Professional Committee, Chinese Society of Astronautics, Editorial Board Member of Computer Measurement & Control, Project Evaluation Expert of National Natural Science Fund Committee, and a peer reviewer for the World Famous International Journal of Applied Physics Letters, Journal of Applied Physics, Smart Materials and Structures. He has authored/co-authored over 22 journal publications or conference papers in these fields. He applies to the patent authority for 30 invention patent.