

Magnetic Miniature Robots for Translational Biomedicine: From Individual to Collectives

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Abstract – Robotics at small scales has attracted considerable research attention both in its fundamental aspects and potential biomedical applications. As the characteristic dimensions of the robots or machines scaling down to the milli-/microscale or even smaller, they are ideally suited to navigating in tiny and tortuous lumens inside the human body which are hard-to-reach by regular medical devices. Although the materials, structural design, and functionalization of micro-/nanorobots have been studied extensively, several key challenges have not yet been adequately investigated for in vivo applications, such as adaptive locomotion in dynamic physiological environments, in vivo localization with clinical imaging modalities, the efficiency of therapeutic intervention, biosafety, and their autonomy for the intervention tasks. In this talk, I will first present our recent research progress on development of magnetic miniature robots, from individual, multiple agents to the microswarms, for rapid endoluminal delivery. Then the key challenges and perspective of using magnetic miniature robots for targeted delivery and clinically relevant applications with a focus on endoluminal procedures will be discussed.



Prof. Li Zhang is a Professor in the Department of Mechanical and Automation Engineering (MAE) and a Professor by Courtesy in the Department of Surgery at The Chinese University of Hong Kong (CUHK). Dr. Zhang's main research interests include small-scale robotics and their applications for translational biomedicine. He has authored or co-authored over 300 publications, including *Science Robotics*, *Nature Machine Intelligence*, *Science Advances*, *Nature Communications*, *TRO*, *IJRR*, *SoRo*, *Annual Review of Control, Robotics, and Autonomous Systems*, as the corresponding author. Dr. Zhang has won several awards from IEEE international conferences, including MARSS2022, 3M-NANO2021, CASE2020, ARM2020, and so on. He won the Hong Kong Research Grants Committee (RGC) Early Career Award in 2013, CUHK Research Excellence Award 2019-20, and RGC Research Fellow (RFS) Award 2021/22. Dr. Zhang is a Fellow of IEEE, Royal Society of Chemistry, and Asia-Pacific Artificial Intelligence Association.