

**Department of Electrical and Computer Engineering
Materials Engineering Program**

**Texas Center for Superconductivity at Univ. of Houston
Center for Integrated Bio and Nano Systems**

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Magnetic Nanoparticle Swarm for Active Delivery

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Abstract: In nature, various types of swarm behaviors occur, such as a flock of birds and a swarm of ants, which stem from local communications of limited individuals. Through collective pattern formation and reconfiguration, these animals dramatically change their swarming patterns according to the environment they interact with. To date, some large-scale robotic systems can well mimic the complex swarm behaviors of natural creatures through algorithm design and wireless communication (Science, Vol. 345, 795–799, 2014). However, due to the absence of onboard processors, sensors and actuators, to create a robotic system with functional swarm behaviors at the small scales remains challenging.

Recently, my group has developed a strategy that select the optimised magnetic nanoparticle swarms (MNS) in different bio-fluids, such as blood and vitreous humor (Nature Communications, 2019, DOI: 10.1038/s41467-019-13576). The swarms reported may have great potential in medical applications, and this work is an important intermediate step from fundamental understanding of nanorobotic swarms to their clinic applications.

In this lecture, I will present the recent research progress on the design and development of MNS from the following four aspects: (i) controlled generation of reconfigurable swarming pattern; (ii) motion control of the MNS; (iii) selection strategy of the MNS in varied biological fluids; (iv) the perspective of the MNS for biomedical applications.



Short Bio: Dr. Zhang is a senior member of IEEE, who has won several awards or in the Finalist from IEEE international conferences including ICRA IROS, ROBIO and NANOMED. Since 2004 he has authored and co-authored

over 200 papers, including Science Robotics, Science Advances, Nature Communications, TRO and IJRR. He won the Hong Kong Research Grants Committee (RGC) Early Career Award in 2013, and the CUHK Young Researcher Award 2017. He currently serves as an Associate Editor of IEEE/ASME Transactions on Mechatronics (TMECH), IEEE Transactions on Automation Science and Engineering (TASE), IEEE Robotics and Automation Letters (RA-L), and IEEE Open Journal of Nanotechnology (OJNANO).