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Design and application of force-sensing robotic bio-micromanipulation systems

Robotic micromanipulation systems are demanding devices to realize automated manipulation of biological samples. Majority of existing robotic bio-micromanipulation systems work based on displacement sensing and control. The lack of force sensing prevents the wide application of the devices. In modern biotech industry, there are increasing needs for advanced micromanipulation equipment with microforce sensing and control capabilities. The development of force-sensing microinjectors and microgrippers enable extensive applications involving biological field with guaranteed safety and accuracy of advanced robotic manipulation. This talk reports our recent work on design and development of new force-sensing robotic micromanipulation systems dedicated to biological micromanipulation tasks. In particular, force-sensing microinjector and force-sensing microgripper are presented as typical examples. New microforce sensor design is conducted in details. Novel control schemes have been developed to fuse the position and force control to enable a safe and reliable manipulation. The effectiveness of the systems has been demonstrated by carrying out microinjection and microgripping operation of biological cells. The developed force-sensing robotic bio-micromanipulation systems have demonstrated wide applications in the fields of biomedical engineering, gene engineering and so on.

Biography

Qingsong Xu is the Director of Smart and Micro/Nano Systems Laboratory and Associate Professor of Electromechanical Engineering at the University of Macau. He was a Visiting Scholar at the University of California, Los Angeles (UCLA), USA in 2016, the RMIT University, Melbourne, Australia in 2016, the National University of Singapore, Singapore in 2012 and the Swiss Federal Institute of Technology (ETH Zurich), Switzerland in 2011. His current research area involves micro/nano-mechatronics and systems, control and automation and applications of computational intelligence. He is a Senior Member of *IEEE* and a Technical Editor of *IEEE/ASME Transactions on Mechatronics*. He has published three monographs and over 240 technical papers in international journals and conferences.

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