Online Iterative Learning Enhanced Sim-to-Real Transfer for Efficient Manipulation of Deformable Objects

Prof. Shuai Li
Faculty of Information Technology and Electrical Engineering
University of Oulu
Pentti Kaiteran Katu 1, 90570 Oulu, Finland
Shuai.Li@oulu.fi

Abstract: Deformable manipulation has attracted a lot of attention in the field of robotics, especially in medical applications. However, manipulating deformable objects faces various challenges, mainly including their complex dynamic properties and unpredictable nonlinear deformations. It is difficult to provide a basis for deformable object measurements without effective control methods that provide intelligent and accurate position control, and this research also provides a premise for deformable object measurements. To address these issues, proposes an online iterative perception policy method (IPP), which does not require large-scale deep network training, is able to perceive transformations through an iterative process, and achieves efficient and accurate control of deformable objects. Extensive experiments in the simulation environment and the real scene are conducted to validate the effective and superiority of proposed method, as well as to compare with advanced algorithms (LQR, SMC, MPC, and Heuristic). The experimental results reveal that IPP outperforms other approaches in terms of convergence, stability, robustness, and flexibility in both the simulation and real-world scenarios, regardless of textile properties or initial conditions.

Short CV: Shuai (Steven) Li received the B.E. degree in precision mechanical engineering from the Hefei University of Technology, Hefei, China, in 2005, the M.E. degree in automatic control engineering from the University of Science and Technology of China, Hefei, in 2008, and the Ph.D. degree in electrical and computer engineering from the Stevens Institute of Technology, Hoboken, NJ, USA, in 2014. He is currently a full Professor with University of Oulu, Finland. His main research is on robot manipulation and impedance control, computational intelligence, intelligent optimization and control.