Abstract

Rapid advances in the research and development of robotic and automation technologies have completely revolutionized the manufacturing industries in the past years. Though much progress has been obtained in the research and development of robotic manipulation recently, it is still difficult to reproduce such achievement in the micro-world as the study of micro-manipulation opens up new research and technological issues which diverge from traditional robotic manipulation.

This research aims to develop robotic manipulation techniques for optical tweezers that are able to manipulate biological cells or microscopic objects using multiple laser-driven fingertips. In the research, multiple optically trapped micro-beads are first utilized as the laser-driven fingertips, and several control techniques will then be explored to achieve various manipulation tasks, which are beyond the capability of manipulation using single optical trapping. The interactions between the manipulators and biological cells or microscopic objects will be analyzed to gain insight into the dynamic manipulation. Both theoretical and practical aspects will be explored in this research.