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Magnetic Levitation for Microrobotics and Micromanipulation

Behrad Khamesee
Department of Mechanical and Mechatronics Engineering
University of Waterloo
Ontario, Canada
Khamesee@uwaterloo.ca

In this talk, a novel technique for micromanipulation using magnetic levitation is presented. The design and development of a microrobotic system based on magnetic principles is described. A teleoperated microrobot is levitated and moved within a 3D space inside a magnetic field with multi-degrees of freedom. The microrobot can be operated in an enclosed environment by transferring magnetic energy and optical signals from outside. As an application of the system, miniature items can be transported and assembled within harsh/hazardous environments.

The integration of the system with a haptic device brings a novel magnetic-haptic micromanipulation platform with promising potential for extensive biological and biomedical applications. A human operator controls the motion of the microrobot via a master manipulator for dexterous micromanipulation tasks. With a patented* force measurement technology, the operator can feel force during micro domain tasks if the microrobot encounters a stiff environment. The effect of hard contact is fed back to the operator's hand in a working envelope of the proposed platform.

* 2017 - US Patent No. 9,689,934 - Method for Providing Force Information in a Magnetic Field Environment Using Remote Measurement of Flux