

# LICENSING OPPORTUNITY

ETH transfer – Linking Science and Business

## Micro motors for wireless actuation and manipulation

### Keywords

Magnetic micro actuator, Wireless motor, Wireless power, Micro manipulation, Quarantine, Implant actuator, End effector

### Background

Many wireless sub-mm size microrobots have been proposed but few working devices have been developed due to challenges regarding propulsion, power transmission, wireless actuators, and control of individual actuators. A new class of wireless actuators was developed at ETH Zurich that combines power and control in the same signal, creating an effective, scalable and usable wireless micro actuator.

Several strategies for wireless motors exist, including electrostatic fields, laser driven thermal impact, absorption and conversion of optical energy, transmission of energy through vibration, etc. Many of these strategies are limited to engineered environments, require dangerous voltages, do not scale well to sub-mm size, or require optical access and exposure and are, thus, quite limited in their use. The use of magnetic fields for wireless actuation is quite popular due to high forces that can be generated over a distance by external fields. By combining the force and distance advantages of magnetism with the behavior of resonant systems, a new type of actuator was developed.

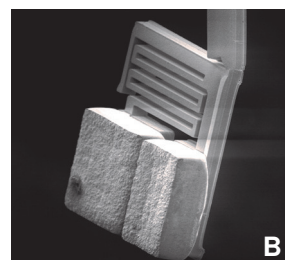
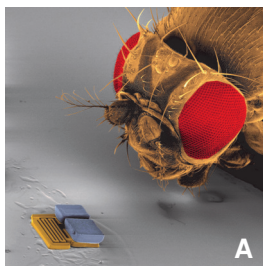


Figure 1A: The micro actuator in relation to a fruit fly; 1B: Close up of the micro actuator, the actual size is 300 x 300 x 70  $\mu\text{m}$ .

### Invention

The invention describes a wireless actuation method where power is transmitted by oscillating magnetic fields. Specially designed actuators capture this power and convert it to a desired form of energy. The actuator responds to specific resonant frequencies so multiple actuators can be driven with the same driving field with the use of time or frequency multiplexing.

The invention is a new class of wireless micro devices (Fig. 1) that can be used in a variety of industrial or medical areas. It has been demonstrated as power source and propulsion for wireless sub-mm robot platforms. Early stage applications focus on wireless end effectors or manipulators, e.g. to harvest protein crystals (Fig. 2). Future applications will focus on smaller designs to be used as micro actuators on microrobots. These may allow the development of a new field of medical microrobots capable of navigating through the body and performing specific tasks.

### Main Advantages

- Operates without wires, circuitry, batteries or antenna
- Wireless motor with high force mechanical energy output (vibration, movement, opening, closing, etc.)
- Operates with a very low magnetic field strength (only 50 times the earth's magnetic field)
- Operates at a natural resonant frequency
- Multiple micro motors can operate simultaneously
- Low costs, disposable

### Field of Application

- Robust micro manipulator for:
  - Protein crystal harvesting
  - Cell sorting and extraction
  - Micro assembly
- Potential as microrobots for:
  - Medical applications
  - Inspection applications
  - Remote sensing
- Future applications:
  - Wireless medical implants
  - Diagnostic systems
  - Drug release systems
  - Ultrasonic emitter

### Patent Status

- Patent pending PCT

Ref. No. T-07-054

ETH Zürich  
ETH transfer  
Zürich, Switzerland

+41 44 632 23 82  
transfer@sl.ethz.ch  
www.transfer.ethz.ch

**ETH**

Eidgenössische Technische Hochschule Zürich  
Swiss Federal Institute of Technology Zurich

# LICENSING OPPORTUNITY

ETH transfer – Linking Science and Business

## Micro motors for wireless actuation and manipulation (cont.)

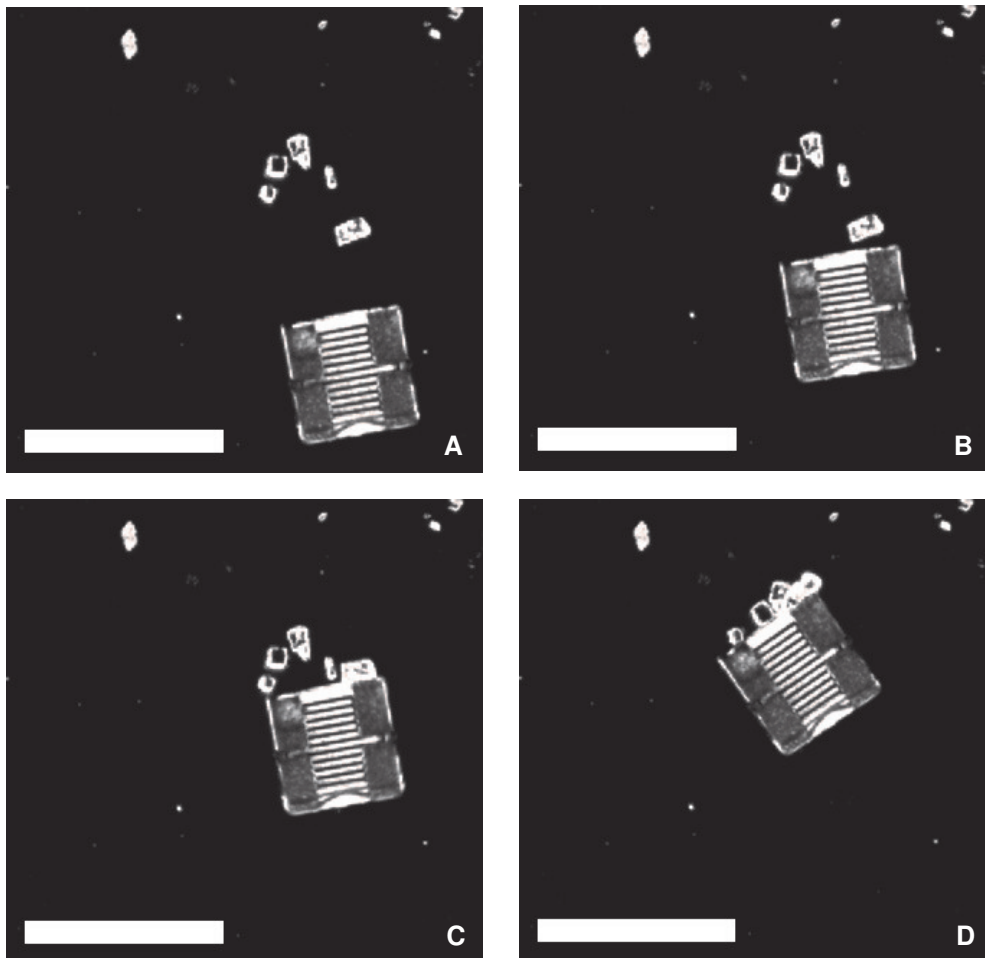


Figure 2A, B, C and D: The micro manipulator is used for protein crystal harvesting, a tedious process that is greatly improved with the presented micro manipulator.

### References

- Video reference. Frutiger et al., Magmites-Wireless Resonant Magnetic Microrobots, ICRA 2008, Pasadena, USA; <http://www.iris.ethz.ch/wrmm.avi> (Firefox is recommended)
- Vollmers et al., Wireless Resonant Magnetic Micro-Actuator for Untethered Mobile Microrobots, Applied Physics Letters, 92(14), 2008
- D. R. Frutiger, B. E. Kratochvil, K. Vollmers, B. J. Nelson, Small, fast, and under control: wireless resonant magnetic micro-agents, The International Journal of Robotics Research (IJRR), invited paper, to appear; <http://www.iris.ethz.ch/wrmm.pdf>

Ref. No. T-07-054

ETH Zürich  
ETH transfer  
Zürich, Switzerland

+41 44 632 23 82  
[transfer@sl.ethz.ch](mailto:transfer@sl.ethz.ch)  
[www.transfer.ethz.ch](http://www.transfer.ethz.ch)

**ETH**

Eidgenössische Technische Hochschule Zürich  
Swiss Federal Institute of Technology Zurich