

Force Control of a Permanent Magnet for Minimally-Invasive Procedures

Stanford researchers have developed a patented method for precisely controlling the force exerted by a permanent magnet for use in medical systems. This system is ideally suited for applications such as robotic catheter placement and endoscopy capsule manipulation. Many minimally invasive procedures that use magnetic guidance either require, or would benefit from, controlling the force exerted by the magnets during the procedure. By placing a magnetically permeable material, one that interacts with magnetic fields, between the patient and the external magnet and then controlling it electromechanically, a variable magnetic shield can be created. This allows the force exerted by an external magnet on an internal device to be altered. This method allows much better force control than is currently possible and it does it in a cheaper, smaller package. The invention provides control over a wide range of force values ideally suited for medical procedures. It also allows some previously impossible procedures to be carried out, due to the increased control. The ability to control the magnetic force also allows smaller magnets to be used because they can now be placed closer to the patient.

The inventors have demonstrated a proof-of-concept system with closed-loop force control that can command arbitrary magnetic forces within a wide range of values. The system also proved the capability to maintain a constant force between a stationary external magnet and a small moving target.

Applications

- Non-invasive device manipulation
- Magnetic placement and steering of catheters
- Controlling endoscopic capsules

Advantages

- Allows precise force control, which previously has not been possible
- No other systems with similar abilities currently exist
- Cheaper and smaller than current systems that require large, constant force magnets
- Increases the range of force control (bandwidth) provided for medical procedures

Publications

- US patent 8,316,861: [System and method for guiding a medical instrument with magnetic force control](#)
- Brewer, R.D. Loewke, K.E. Duval, E.F. Salisbury, J.K., "[Force control of a permanent magnet for minimally-invasive procedures.](#)" Biomedical Robotics and Biomechatronics, 2008. BioRob 2008. 2nd IEEE RAS & EMBS International Conference 19-22 Oct. 2008, 580-586, Scottsdale, AZ.

Patents

- Published Application: [20100105984](#)
- Issued: [8,316,861 \(USA\)](#)

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