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AN OPTIMISED ELECTROMAGNETIC SYSTEM FOR ENDOSCOPIC CAPSULE PROPULSION: REPORT ON A BENCHTOP FEASIBILITY STUDY

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Abstract

Aims: The aim of this work was to design an electromagnetic navigator for capsule endoscopy which incorporated a simplified capsule tracking sensor giving real-time position and to demonstrate the system in a benchtop gastrointestinal model.

Background: Standard capsule endoscopy generates large amounts of redundant video as the unpropelled capsule tumbles through the gastrointestinal under peristalsis. Real-time capsule propulsion has been proposed[1-3,5] as a means to accelerate the capsule's navigation and to facilitate real-time investigation of suspect regions. However, proposed systems are either not optimised for magnetic capsule propulsion[1,4] or are highly complex.[2,3,5]

Methods: An electromagnet was constructed to optimised specifications (approximately 6kg, 18cm diameter, 7cm depth) and mounted on a motorised XY frame for easy of manoeuvrability. User control of the electromagnet was by a gaming joystick. A modified endoscopic capsule replaced the capsule's batteries with a magnet. Real-time steering and tracking capabilities were examined in a simple gastrointestinal model.

Results: The modified capsule was navigated through the 2.5m long model in under 2 minutes. Operator learning time for steering of the electromagnet was typically 30 seconds or less. Maximum separation between the electromagnet and capsule during steering was 7-8cm although this could be increased with forced-cooling of the electromagnet. The presence of the magnetic capsule was detected by Hall effect sensor on the electromagnet's face.

Conclusions: An optimising electromagnetic navigation system overcomes many of the shortcomings of previous approaches to endoscopic capsule propulsion. A video demonstration of the electromagnetic navigation system is available for viewing at: http://youtu.be/ax3C207yZnQ

References

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