

Robotic requirements for diagnosis and therapy with ultrasound capsule endoscopy

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Research into the addition of ultrasound functionality to the now well-established video capsule endoscopy (VCE) is under way in various places around the world. Such ultrasound capsule endoscopy (USCE) brings with it additional demands relating to the possibility for robotic control of the capsule. These relate to three specific features of USCE devices under development in the UK EPSRC-funded Sonopill programme. First, the capsule may be tethered or untethered, with the former providing direct physical means of delivery of power and control signals and therefore the best proximate target for research. Second, as an ultrasound device, the capsule requires a continuous soft solid or liquid path to the region of the gut wall subject to imaging. Limited research to date suggests that this is relatively straightforward to achieve, at least in an intermittent fashion. Third, ultrasound offers the potential for both imaging and therapy, with the latter making stronger potential demands on the dexterity of the robotic solution that is required, for example to allow the capsule to be established in a static position relative to a particular area of the gut wall to allow treatment to take place. In this paper, we explain these key differentiating features and consider their impact on the requirements of robotics for USCE.

The authors are members of the approximately 30-strong Sonopill programme team, which is led by Prof. Cochran, with Dr Cox as Clinical Research Fellow and Dr Vipin Seetohul as a Postdoctoral Research Assistant in its Clinical Theme.

Prof. Cochran's expertise lies principally in ultrasound devices and systems, in which he has been an author of more than 250 journal and conference papers and presentations. Dr Cox has worked in various fields, most recently in focused ultrasound surgery with soft-embalmed cadavers and now in identifying and developing clinical targets for USCE. Dr Seetohul's PhD was awarded for work on technical aspects of ultrasound and he now has particular responsibility for pathfinder capsule development to allow rapid progress towards the testing of various aspects of USCE and other complementary modalities.