

Project Summaries for 2003

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Grant awarded £5,995 (1 Year)

Can Wireless capsule endoscopy be of use in assessing small bowel Crohn's Disease and its treatment? – A pilot study assessing the possible role of colour as well as traditional computer vision methods to help solve the problems of image retrieval and analysis.

The endoscopic appearance of Crohn's disease may include erythema (redness) aphthoid, snail-track and linear ulceration (which often look white or yellowish), thickening of mucosal folds, nodules, stenosis (narrowing) or fistula formation. Flexible endoscopes have improved considerably since those first developed in the 1960's. Fiber-optic endoscopes have been largely supplanted by video endoscopes which have a CCD camera near their steerable bending tip. Good views can be obtained of a patient's foodpipe, stomach and duodenum using a standard forward viewing gastroscope. Similarly good views can usually be obtain of a patient's anus, rectum, colon and terminal ileum (the last bit of the small intestine) using a colonoscope. Examination of the 22 odd feet of small intestine using an endoscopic method has until very recently been difficult and rather unsatisfactory. Two types of very long endoscopes (or so-called enteroscopes) are currently in use to try to look at the small bowel. These are called push enteroscopes and Sonde enteroscopes. Push enteroscopes are 2.1-2.5 meters long and with the help of a stiffening overtube (to splint the stomach and prevent the instrument curling up or looping) a skilled endoscopist may be able to examine the jejunum (upper small bowel) in its entirety. However push enteroscopes don't go down the small bowel far enough to look at the ileum (the lower half of the small bowel). To do this, ultra thin Sonde enteroscopes are used in which a balloon is inflated on the enteroscope tip once the endoscope is into the top of the small intestine. Such instruments rely on the bowel's own peristaltic movement to slowly propel it the length of the small bowel. Such examinations are rarely performed since it can take up to 4-6 hours to get right along the 22 feet of bowel and thus can be very distressing to the patient despite adequate sedation and pain-killers. At the present time the commonest way of assessing the small bowel is to use barium contrast radiographic techniques such as barium meal and follow through. X-ray techniques expose the patient to a radiation hazard (particularly in young patients with Crohn's disease who may require several such tests throughout a life time.

Wireless capsule endoscopy is an exciting new method of examining a patient's entire small intestine. The capsule has a diameter of 11mm, a length of 26mm and is swallowed by the patient. The intestine is illuminated through the capsule's optical dome by white light emitting diodes (LEDs). A camera takes pictures twice a second and relays the data via radiowaves to a little receiver worn by the patient. The patient is thus free to do whatever they like(within reason) for the 8 hours of the test. The image data stored on the receiver/recorder can then be transferred to a workstation/PC computer for later analysis.

Most studies using the capsule endoscope have involved patients who have a problem with recurrent anaemia due to occult bleeding from the small intestine. Since the capsule has taken 2 pictures per second for 8 hours that can mean having to look at 40,000 images! This can take several hours and rapidly becomes extremely boring

and so lesions can easily be missed. It has been suggested that the capsule endoscope may be useful for studying the small bowel of patients with Crohn's Disease. Special even smaller capsules are being designed for use in children. The capsule has the advantage over an X-ray of not involving radiation exposure and also being able to detect very subtle early changes of the disease. Thus it should be possible to study the same patient several times both before and after a particular treatment or operation.

We wish to see if we can develop a computer-based technique for finding any images which might show changes of Crohn's disease in the small intestine as indicated by an abnormal distribution of yellow or white areas on the images. If so we wish to find a way to quantify any abnormalities so detected.

Dr Jeff Behrens and Dr Mark Fisher, both computer scientists at UEA with special expertise in using colour distributions for image analysis and motion tracking, will work with two gastroenterologists in East Anglia with an interest in capsule endoscopy namely, Dr Crawford Jameson and Professor Duncan Bell.