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PhD subject

Multimodal contact servoing on a deformable liver

PhD abstract :
Liver cancer is a leading cause of cancer death worldwide. An estimated 830,000 people around the world died from the disease in 2020. Liver resection is considered as one of the most effective treatments. In this respect, laparoscopic liver resection (LLR) comes up by reducing substantially patient trauma compared to open liver resection. The patient recovers faster which in return reduces healthcare costs.

However the use of LLR remains limited. This is because of three challenges. First, controlling intraoperative bleeding using laparoscopic instruments requires advanced technical skills. Second, the surgeon cannot manually palpate the liver and thus cannot locate the tumours and their resection margins easily. Consequently this raises a risk of inadequate resection on the patient's liver such as the removal of too much healthy tissue and the leaving of some cancerogenous tissue behind. Third, laparoscopic ultrasonography (LUS), the only tool for intraoperative subsurface imaging which allows real-time tumour localisation, has a long learning curve. This is because its design consists of a small transducer with a small field of view attached to the end of a long shaft with a pivoting mechanism.

In order to ease LLR, robotic solutions would provide a great assistance by controlling the LUS. For that, the goal of this PhD is to develop and implement a solution for contact servoing of a flexible ultrasound probe on the deformable liver surface. The setup includes a robotic arm mounted with a flexible ultrasound probe, a camera and a phantom liver organ. Contact servoing will be based on the images of the camera and the ultrasound probe.
The objectives are: 1. to segment the liver; 2. bring the ultrasound probe in contact with the liver; 3. to move the probe on the liver surface.

The PhD will be in close collaboration with the scientists and surgeons where the successful outcome of this PhD will simplify mini-invasive liver surgery. It will shorten hospital stays, improve surgical safety and accuracy, and contribute to an overall better quality of patient life and reduction of healthcare costs.