Augmented reality navigation based on surface matching registration in laparoscopic liver surgery

Background

One of the biggest challenges during navigated laparoscopic liver surgery is to acquire accurate registration of the pre-operative model and the intra-operative scene [1]. The registration process is error prone because the liver deforms during the surgery and is also challenging for the surgeon. The two mainly used registration strategies are landmark-based (derived from surface points or ultrasound landmarks) or vessel-based. Surface matching is less used, as it is difficult to acquire a surface using a rigid instrument on a deformable and soft organ. Currently, stereo laparoscopy is becoming more widely used which allows to reconstruct a surface from the video images. This could reduce the complexity for the user and provide an alternative ease to use registration strategy for registration of soft and deformable organs as the liver.

Aim

To evaluate the accuracy and clinical applicability of surface matching-based registration in laparoscopic surgery using stereo video derived surfaces.

Materials and Methods

During this project the candidate will develop a registration workflow based on surface matching. Video and tracking data will be acquired during an ongoing study with an augmented reality navigation system. This data will then be used to develop a surface reconstruction and surface matching method to register the pre-operative model. This method will then be integrated into the current navigation system and evaluated during future surgeries using the augmented reality navigation system.

Work shares of the Thesis

- Software development: 40 %
- Image processing: 30 %
- Experimental study: 30 %

Skills and interests of thesis candidate

- Programming in C++/Python
- Stereo image processing
- Interest in soft-tissue surgery
- Image-guided surgery
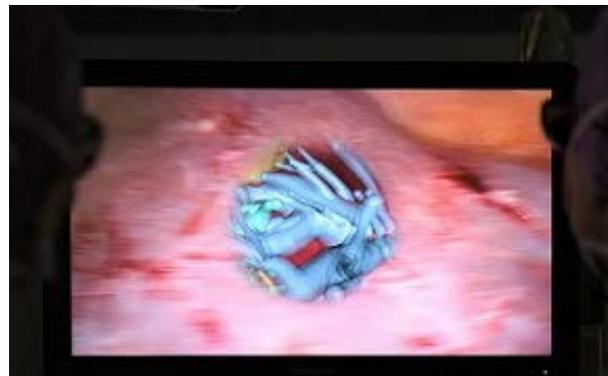
References

1.   Kenngott HG, Wagner M, Nickel F, Wekerle AL, Preukschas A, Apitz M, Schulte T, Rempel R, Mietkowski P, Wagner F, Termer A, Müller-Stich BP (2015) Computer-assisted abdominal surgery: new technologies. Langenbeck's Arch Surg 400:273–281

Supervisors

Iwan Paolucci, Ankit Gupta

Examiners

Prof. Dr. Stefan Weber, Iwan Paolucci

Institute

Image Guided Therapy, ARTORG Center for Biomedical Engineering, University of Bern

Contact

Iwan Paolucci, iwan.paolucci@artorg.unibe.ch, Murtenstrasse 50 CH-3008 Bern, Tel. 031 632 75 80