Karlsruher Institut für Technologie

Institute of Biomedical Engineering

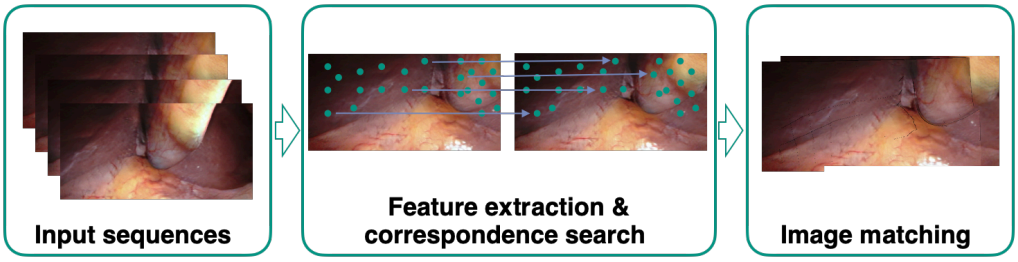
IBT

Master Thesis

Image Stitching to Expand the Field of View in Laparoscopic Liver Surgery

Motivation

Laparoscopic liver surgery is a minimally invasive surgical technique that offers several advantages over traditional open surgery. It involves smaller incisions, resulting in less pain and scarring for the patient. However, laparoscopic surgery is more technically challenging than open surgery and requires highly qualified surgeons. One specific challenge is the limited field of view, which allows the surgeon to only see a small part of situs, in our case the liver. Thus, it would be beneficial to extend the field of view. Recently, diverse learning-based approaches to stitch consecutive images (video frames) are published. Moreover, first applications in case of endoscopic images were proposed. However, in case of liver surgery, due to the smooth surface of the organ, hardly any features (edges, characteristic points) are available which makes the stitching considerably difficult.



Project Description

The first part of the project covers a literature research to get a comprehensive overview of recent approaches of image stitching with focus of endoscopic or laparoscopic images. In the next step, promising approaches should be implemented and, if reasonable, adaption to the application in laparoscopic liver surgery should be integrated. The approach probably consists of the following steps: (1) relevant features in the images have to be extracted (2) corresponding features (same pixels in the images) should be found (3) the images should be matched using the corresponding features and the extended field of view is available (see figure above). Moreover, the pipeline should be evaluated in two ways: First on synthetic consecutive images, due to available ground truth information a quantitative evaluation can be performed. Second, a qualitative evaluation on clinical video frames. Depending on the interests of the student, the project can be extended by including a comparison of the image stitching with handcrafted feature detection methods (e.g., SURF or SIFT). An alternative would be a comparison with depth map stitching, which are also available for the synthetic images.

Notes

- Programming skills in Python or similar languages
- Motivation and fun, also when contributing your own ideas, are highly desirable

Research field
Optical Technologies in Medicine

Project
Registration of pre- and intraoperative data for the navigation in laparoscopic liver surgery

Focus
Literature research, software programming, method implementation and comparison

Degree programs
Biomedical Engineering; Computer Science and Engineering

Starting date
As soon as possible

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