University of Basel

Department of Biomedical Engineering

Evaluation of Tracking Algorithms for a Visually Servoed Robotic Endoscope

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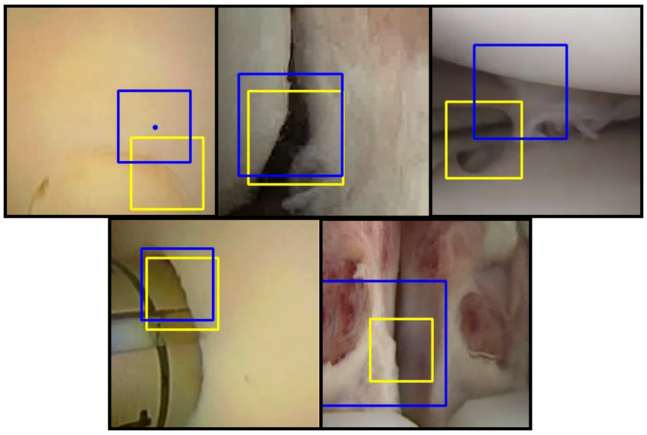
Master Thesis

An endoscope prototype with an integrated miniature camera was built to track a target during arthroscopies. (Image: Stephan Schraivogel)



Arthroscopic videos were used to compare different tracking algorithms from an existing computer vision library for robustness and precision. The yellow frame shwos the ground truth target location, the blue frame where the tracking algorithm assumes the target to be. (Image: Stephan Schraivogel)

Controlling dexterous surgical instruments through small skin incisions is still a major challenge for surgeons during minimally invasive surgery. Automating the steering of the endoscope could help the surgeon to focus on the actual surgical task.

As a first application, we automated the steering of an endoscope to keep a moving target in its field of view during an arthroscopy. A miniature camera was embedded in an endoscope prototype with two degrees of freedom (pitch up and down, yaw left and right). The images of this camera were processed in real-time and the extracted information were used to control the movement of the endoscope. For the image processing, we compared different tracking algorithms from an existing computer vision library. In a first step, these tracking algorithms were applied to already recorded arthroscopic videos to get a measure of their robustness and precision. Afterwards, the most promising algorithms were used for an experiment on the real endoscope prototype in order to evaluate the entire control system.

The experiments showed that vision-based control is a promising approach to automate the steering of the endoscope and that existing algorithms can be used to track targets even in challenging scenarios like arthroscopies.

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