



Project Proposal

Project Management and Software Development for Medical Applications

General Info

Project Title: Needle tracking for ultrasound-guided biopsies with inside-out vision

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Project Abstract

Using an existing miniature stereo camera setup to track a punch biopsy needle, the goal of this project is to develop a software prototype that projects the 3D location of the needle tip onto the ultrasound image plane. In the future such a systems can ease the process of tissue extraction for the physician by adding additional information to the ultrasound image during the intervention.

Background and Motivation

Ultrasound-guided needle biopsy is a common invasive method to diagnose early stage cancer. During the ultrasound-guided intervention, a needle is inserted into the area of interest within the body and a sharp cutting instrument at the tip of the needle then extracts the tissue. The specimen is analysed by a pathologist afterwards to determine the presence or absence of cancer.

Transrectal ultrasound-guided biopsy is the gold-standard method for diagnosis of prostate cancer. The current approach is either done by the use of multiple needle pathways in order to increase the probability to extract the relevant cells or by using an external tracking system to detect the needle tip and cut out tissues more precisely. The latter requires a number of re-adjustments of the

hardware during the intervention and has line-of-sight issues. The first damages several tissue areas which may cause infections and increase the curative time. Blood in sperm, urine and faeces after the procedure is very common and occur in over 90% of patients. These after effects can persist for several weeks.

The project partner FRAMOS wants to establish a procedure which is free of the disadvantages of outside-in tracking systems and can decrease the number of taken specimina by showing the needle tip on the ultrasound image to ease the localization process and thus helps the physician.

Student's Tasks Description

After stereo calibration with existing routines, the student uses the tracking algorithms of the FRAMOS software framework to get the 3D pose of the needle. A calibration of the needle housing to its tip is done subsequently.

In a consecutive algorithm – which is implemented by the student – the found position of the needle tip is projected onto a known image plane (i.e. the ultrasound image plane). The needle tip position in this plane is then visualized together with its insertion path.

After this project, the student is able to work with the stereo calibration toolbox of MATLAB and the FRAMOS software framework. Some experience with a clinical software interface such as OpenIGTLink is made and a real-time visualization has been implemented and documented. Moreover, the constant coordination with FRAMOS gives some insight into the working procedures in the industry.

Please send the completed document to achilles@in.tum.de before the project proposal deadline on October 1st, preferably earlier. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance.



Technical Prerequisites

- Basic knowledge of MATLAB / C++
- Basic skills in linear algebra

Optional requirements that can also be learned during the project are:

- Basic knowledge of image processing and some experience with openCV
- 2D/3D computer vision expertise
- Basic understanding of projective geometry
- Ability to work with versioning tools such as SVN / GIT

References

Stolka et al. "Needle Guidance Using Handheld Stereo Vision and Projection for Ultrasound-Based Interventions". MICCAI 2014

Zhang, Zhengyou. "A flexible new technique for camera calibration". PAMI 2000