



RGBD SLAM and Point Cloud Registration for spinal surgeries

Project Management and Software Development
for Medical Applications

General Info

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Project Abstract

In this project, recent SLAM and point cloud registration techniques are explored. This constitutes an experimental step towards marker-less tracking in spinal surgeries.

Background and Motivation

Due to numerous technological advancements, 3D sensing is becoming more accurate and affordable. Modern sensors capture scans of the environment in the shape of 3D points, called point clouds and provide large amounts of point cloud data at high frame rates. Assembling point clouds into more comprehensive ones requires aligning them along distinctive shapes that are common to the scans. In computer vision, point cloud registration is the process of finding a spatial transformation that aligns two-point clouds and necessitates in uncovering the relative transformation between their local coordinate systems.

Conventional iterative methods such as ICP are commonly used for point cloud registration. Soft assignment is another iterative approach which assigns correspondences to estimate 6D poses. In the last years, the use of conventional 3D descriptors to register clouds has been investigated more.

This project leverages these observations and aims to explore the potential of point clouds registration in the context of spinal surgeries when marker-less tracking systems are employed.

Student's Tasks Description

Implementation/integration of a state-of-art software solution for:

- SLAM on spinal surgeries using RGBD images
- Point Cloud extraction from RGBD images acquired with a Realsense camera
- Test Point Cloud extraction with a spine phantom
- Point Cloud extraction from the CT of the phantom
- Registration of the two extracted point clouds

Technical Prerequisites

- Experience with C++ and/or Python
- Experience with ROS could be beneficial.

References

B. Busam et al. „Markerless Inside-Out Tracking for 3D Ultrasound Compounding“. MICCAI/POCUS 2018.

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G. K. Tam, Z. Q. Cheng, Y. K. Lai, F. C. Langbein, Y. Liu, D. Marshall, R. R. Martin, X. F. Sun, and P. L. Rosin. Registration of 3d point clouds and meshes: A survey from rigid to Nonrigid, 2013.

R. B. Rusu, N. Blodow, and M. Beetz. Fast point feature histograms (fpfh) for 3d registration. In 2009 IEEE international conference on robotics and automation, pages 3212– 3217. IEEE, 2009.

J. Yang, Z. Cao, and Q. Zhang. A fast and robust local descriptor for 3D point cloud registration. Information Sciences, 346-347:163–179, 6 2016.

Please send the completed proposal to javier.esteban@tum.de, ardit.ramadani@tum.de, mf.azampour@tum.de and zl.jiang@tum.de. The proposal will be evaluated by the BMC coordinators and assigned to a student only in case of acceptance.