Master's internship – 2025

Low-tech 2D-3D registration for percutaneous surgery guidance

Supervision:

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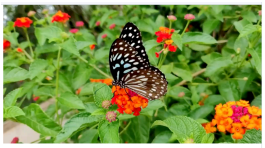
Context:

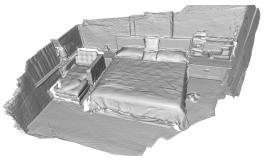
Intraoperative surgical navigation and guidance for percutaneous procedures have been mostly studied independently from trajectory planning. They often use expensive tracking devices and complicated setups, that are not always easy to use or available in all operating rooms. On the other hand, most preoperative trajectory planning systems have been proposed without any link to intraoperative guidance. The purpose of this work is to move forward and guide the surgeon intraoperatively, to perform needle insertions following the selected plan, using only a simple camera or smartphone.

Work description:



The objective is first to propose and implement an algorithm pipeline that will create a point cloud from 2D images, reconstruct a 3D mesh, and register the preoperative 3D scene to the captured scene. The images will be acquired using only a simple webcam or a smartphone camera. The second task is to overlay in the 3D scene the trajectory preoperatively selected, to guide the insertion. The algorithm should work in interactive time for the best usability in a real scenario.

The study will try different approaches, using libraries such as OpenSfM (github.com/mapillary/OpenSfM), DepthAnything (github.com/DepthAnything/Depth-Anything-V2), or Open3D (open3D.org), and use the power of deep learning and GPU.



Major aspects of the work are a focus on fast computations to ensure real-time performance of the algorithm, and the usability in the OR thanks to an ergonomic display of the trajectory to follow. To validate the approach, experiments will be conducted on a medical gel phantom and the corresponding surface mesh reconstructed from a CT scan of the phantom, using a provided camera.

Team and environment:

The internship will be part of a collaboration between multiple disciplines (computer vision, geometric modelling, medicine) and co-supervised by experienced researchers and MD, and PhD students.

The intern will be hosted in an office at the ICube Institute, Illkirch Campus of Strasbourg, and have access to all the necessary hardware and IT resources. The intern will occasionally go to the IHU Strasbourg.

The development will be done in C++ or python.

Internship duration: 5-6 months, starting January, February or March 2025.

Profile: MSc with a major in computer science, computer graphics, image processing, or related fields. Proficiency in C++ and/or python is required.

For further information and application, please contact the supervisors.