Motion Planning Framework for Insertion of a Robotic Endoscope in the Human Knee

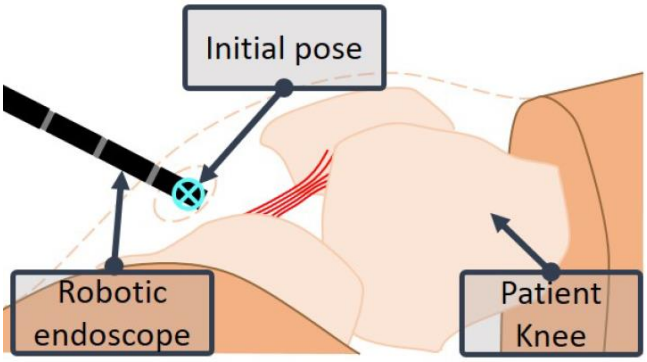

Figure 1: Human knee with a robotic endoscope at the initial pose directly in front of the anteromedial portal (Picture: G. König).

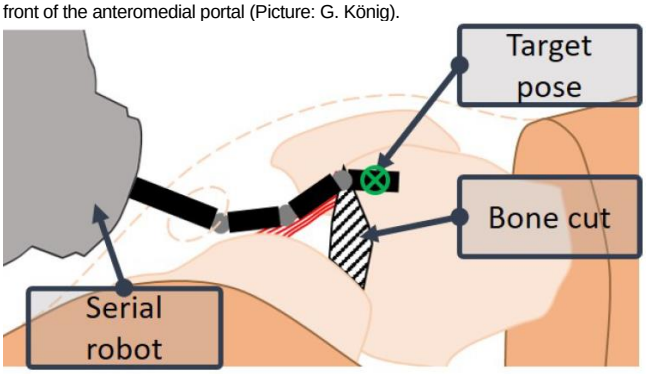

Figure 2: The approach path of the endoscope respecting the anatomical constraints and the surgeon's preferences is computed for a specic target pose, using motion planning algorithms (Picture: G. König).

Master Thesis by Gabriel König (ETH Zürich) at BIROMED-Lab.

To perform minimally invasive knee surgery with a robotic instrument, the instrument's motion starting from its initial pose at the surgical portal for incision to its final target pose inside the knee needs to be planned carefully. This motion planning is a challenging task due to the complexity of the robotic instrument (13 degrees of freedom) and the constraints based on the anatomy of the patient (hard and soft structures) and input from the surgeon (desired motion).

After a thorough evaluation of different software environments for motion planning, we selected MoveIt as the development platform with the Open Motion Planning Library (OMPL) as the underlying planning library and the Flexible Collision Library (FCL) as the collision detection library.

We successfully developed a test scenario and a user interface that allows planning a feasible motion of the robotic instrument that is currently being developed at the BIROMED-Lab within the scope of the MIRACLE project based on desired initial and target poses while respecting anatomical and user-defined constraints.

Supervision:
Manuela Eugster
manuela.eugster@unibas.ch
BIROMED-Lab

Esther Zoller
esther.zoller@unibas.ch
BIROMED-Lab

Prof. Dr. Georg Rauter
georg.rauter@unibas.ch
BIROMED-Lab

Prof. Dr. Robert Riener
ETH Zürich