



# Automatic Pose Synchronization

Project Management and Software Development  
for Medical Applications

## General Info

Project Title: Automatic Pose Synchronization

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## Project Abstract

Different medical instruments and robots move separately in the operating theatre. To fuse data that arises from attached sensors or visualize the position and orientation of these objects accurately in space, the involved pose streams need to be aligned. A prototype that minimizes latency of the pose streams and reduces network lags is developed.

## Background and Motivation

In many medical procedures, multiple pose information streams are relevant. Robot-guided surgery for example can include a tracking system to observe the movement of a medical instrument while the robot end-effector interacts with its environment to support the physician. These systems oftentimes run on different machines or produce pose streams for their own and medical instrument's positions that arrive at a common computing unit have different lags at different times.

Despite their advantages in accuracy and reliability, even optical trackers suffers from limited acquisition rates depending either on intrinsic sensor capabilities or physical limitations such as exposure time which naturally result in limited temporal resolution of their pose streams.

To further process sensor data, align modalities or augment relevant additional information on medical images, knowledge about the actual position and orientation of the involved components is crucial. In order to do that the different pose streams need to be synchronized in time and the lag due to sampling should be minimized to provide a lag-free experience in real-time with the capability of dead reckoning in case of pose losses.

With the use of quaternionic upsampling, poses can be continuously interpolated and extrapolated in time. An alignment of different tracking streams can then be modeled as a curve fitting problem.

## Student's Tasks Description

The student starts by exploring the capabilities of quaternionic upsampling on synthetic pose data and develops a first prototype that minimizes the lag of artificial data streams.

After setting up a pipeline that synchronizes several data streams, one target is to use the results in real-time. For this, a generic interface via TCP/IP that enables the communication with the FRAMOS Optical Tracking System (OTS) is implemented to collect 6D pose data. In a defined test scenario, the prototype is finally tested and the performance is evaluated.

After this project, the student is able to work with optical tracking systems. Experience with the clinical software interface OpenIGTLink is made and a pose synchronization method has been implemented and documented. Moreover, the constant coordination with FRAMOS gives some insight into the working procedures in the industry.



### Technical Prerequisites

- Basic knowledge of MATLAB / C++
  - Basic skills in linear algebra and optimization
- Optional requirements that can also be learned during the project are:
- Basic understanding of geometric algebra
  - Ability to work with versioning tools such as GIT

### References

B. Busam et al: "Quaternionic Upsampling: Hyperspherical Techniques for 6 DoF Pose Tracking". 3DV. 2016