Calibration of structured light scanner for intra-operative navigation

Supervisors: Drs. M. Kunz, R. Ellis

Modern handheld structured light scanners, such as the Artec Spider and Eva scanners, have the ability to rapidly, and non-invasively create 3d surface models with high accuracy and resolution. Due to a series of visible light pattern projected onto the object, 3d geometry of the object is determined and a surface model containing geometry as well as texture information is created. A scan of a mid-size object (such as the distal end of a femur) is normally obtained in 2-3 minutes without any need for calibration markers attached to the object. This makes structured light scanners perfect intraoperative image modalities for image-guided surgery systems. During such image-guided interventions a tracking system, such as an opto-electronic camera, is installed in the operating theater and sensors are rigidly attached to anatomies and surgical instruments. The camera reads the information from these sensors and renders the tracked position of the instruments on the virtual representation of the anatomy and/or the planned instrument trajectory.

The goal of this project is to establish the relative position and orientation of the scanned 3d surface model to the position and orientation of a structured light scanner. In a first step, a method will be developed to determine the internal calibration parameters of the scanner. Using these information, a transformation between the coordinate system of the tracker and scanned model will be determine. In a final phase of this project, a preliminary accuracy study will be performed to test the calibration method.

Outline of student's role:

(1) Work in a multidisciplinary technology research lab specialized in computer-assisted surgery. (2) Learn concepts of structured light scanner and surgical environment. (3) Develop workflow for calibration procedure; (4) Develop experimental setup; (5) Develop software (C, C++, or Matlab) for calibration; (6) Carry out measurements and analyze data.