Vitreoretinal surgery addresses sight-threatening conditions on the back of the eye. Since structures on the back of the eye are often only a few micrometers, the technical demands placed on the surgeon by these procedures are very high. Robotic systems can provide a distinct and positive alteration in patient outcome when they can show to really enhance the surgeon’s capability by providing both physical and mental assistance. Although the use of a stereomicroscope provides a three dimensional image to the physician, determining the distance between instrument-tip and retina proves to be very hard.

PRECEYES SURGICAL SYSTEM
The PRECEYES Surgical System is a telemanipulation system consisting of a motion controller (master) and an instrument manipulator (slave). The system filters out tremor and can greatly increase precision by scaling down motion.

PROXIMITY SENSING
The surgical instrument, which is connected to a robotic setup, is equipped with an Optical Coherence Tomography (OCT) probe. OCT is a sensor solution based on interference between two light paths and can be used to measure a one-dimensional depth image (A-scan).

OCT A-scans measured while the instrument approaches the retina with steps of 200μm. Movements due to heartbeat are visible (period ~1s, amplitude ~40μm), especially during instrument standstill.

The retina has a specific shape that is detected in these A-scans. Combining this with robot measurements and the physical properties of the instrument gives the distance between the instrument-tip and the retina.

VIRTUAL BOUNDS
The calculated distance to the retina is now used to limit the motion of the instrument manipulator, thereby providing virtual bounds to the surgeon.