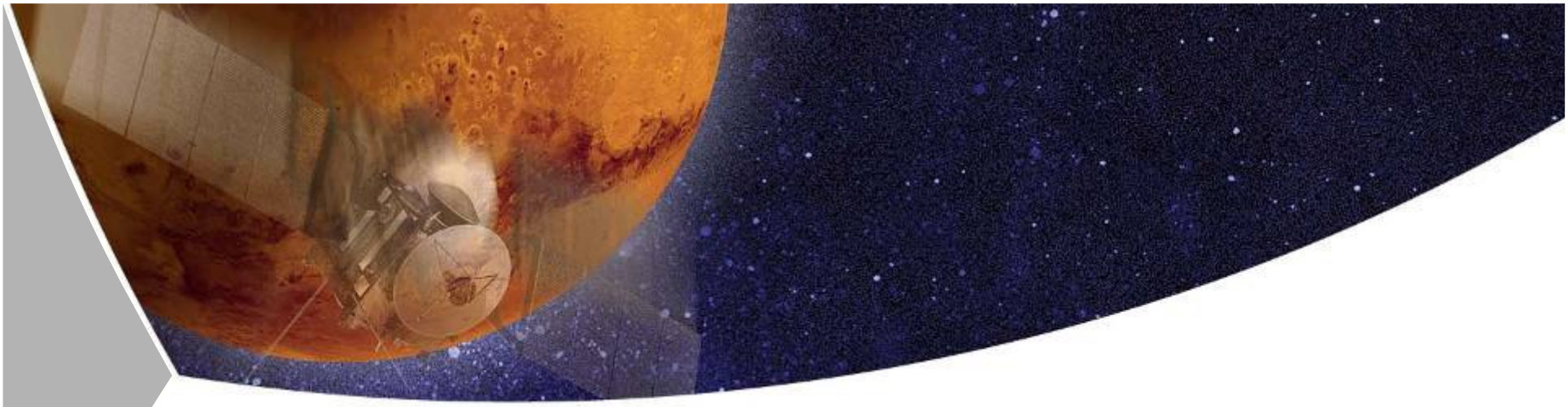


DLR Medical Robotics Group
MiroSurge - A Robotic System for Surgery

Sophie Thielmann

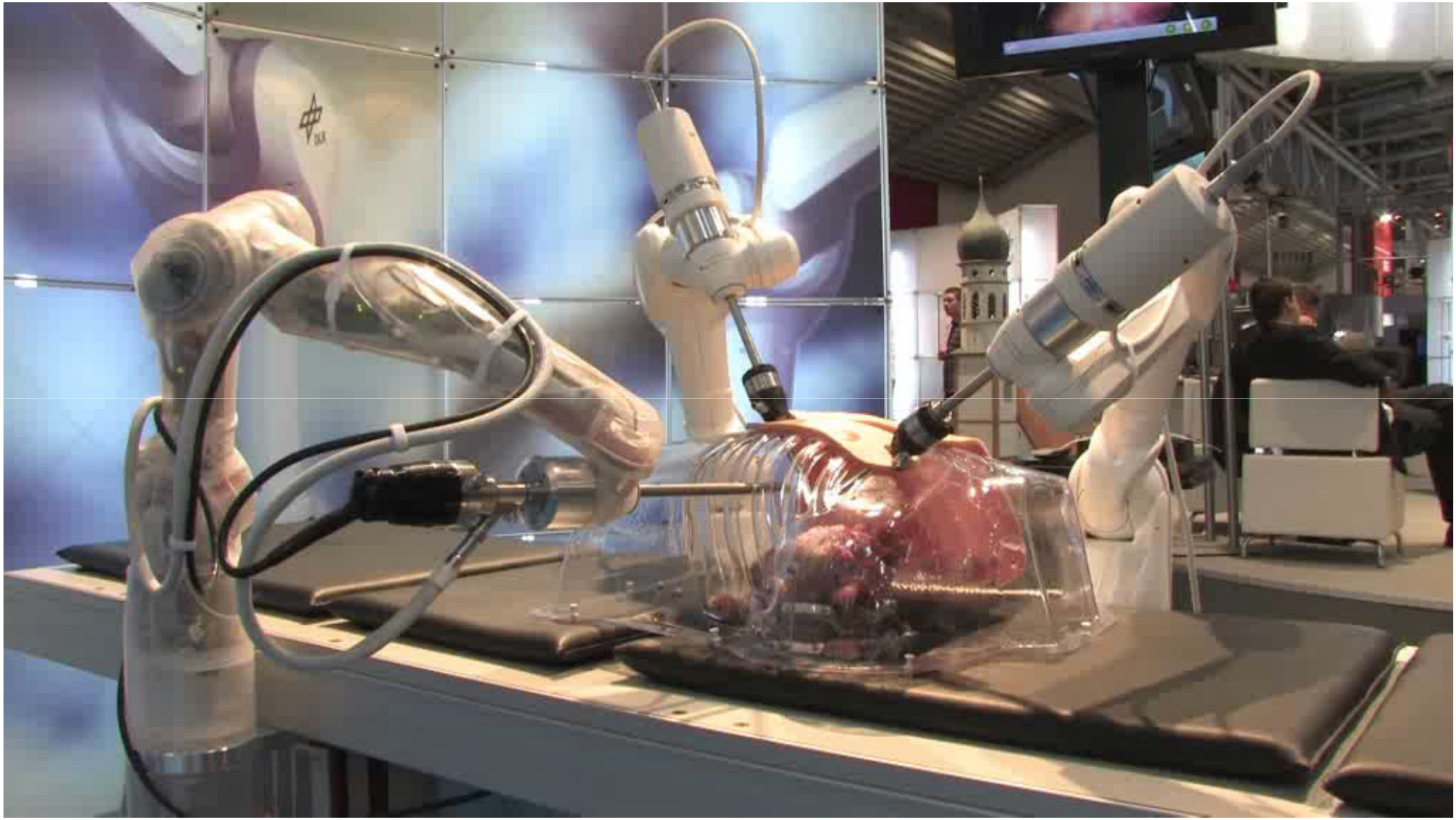
Institute of Robotics and Mechatronics

DLR - German Aerospace Center

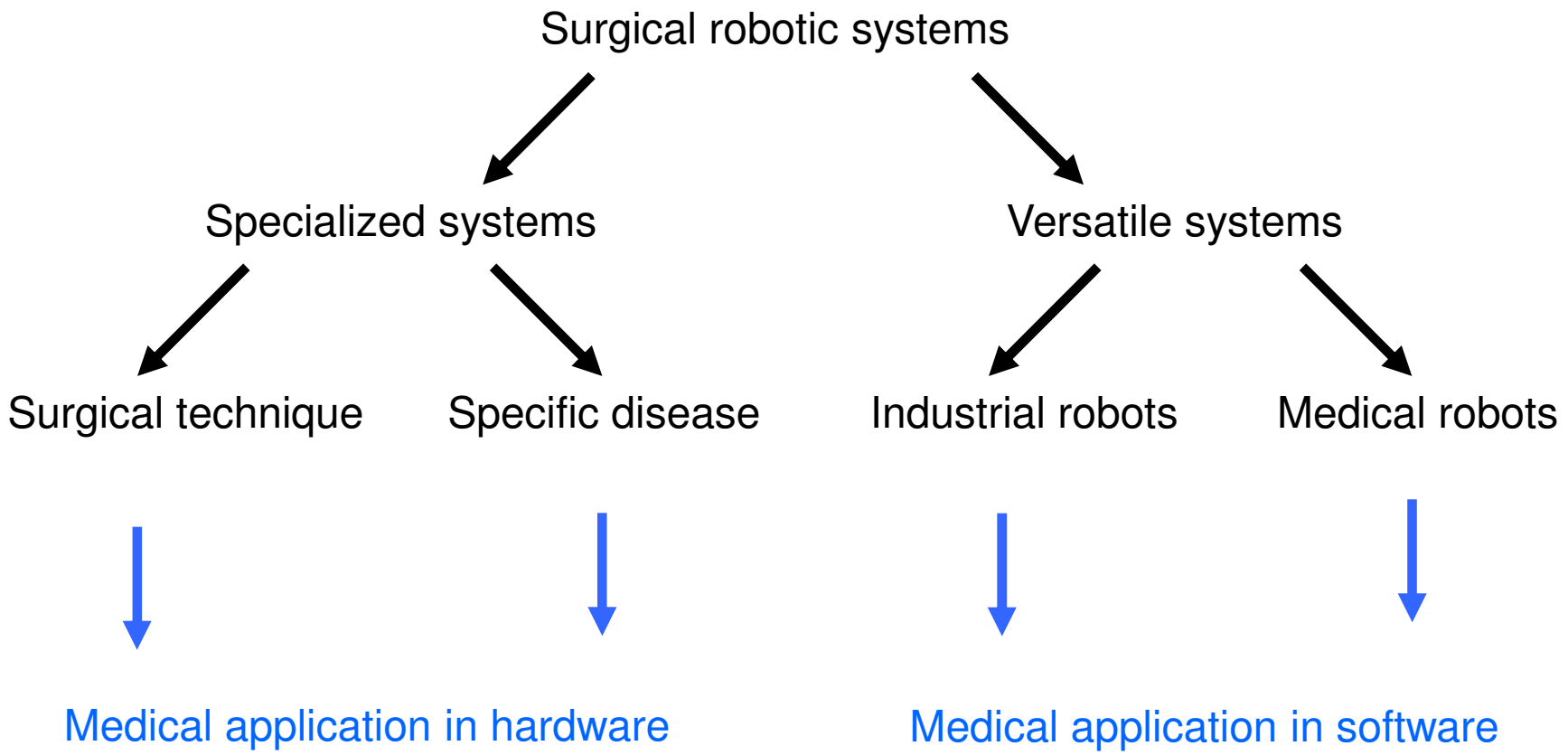
Oberpfaffenhofen (Munich)

Medical Robotics Group

- Group:
  - 12 researchers
  - 5-10 student research assistants
  - 10 researchers with 50% contribution
- Since 2005:
  - 40 publications
  - 25 patent applications
- Cooperations:
  - Several German and European projects
  - Industry: KUKA Roboter, BrainLAB, Richard Wolf GmbH

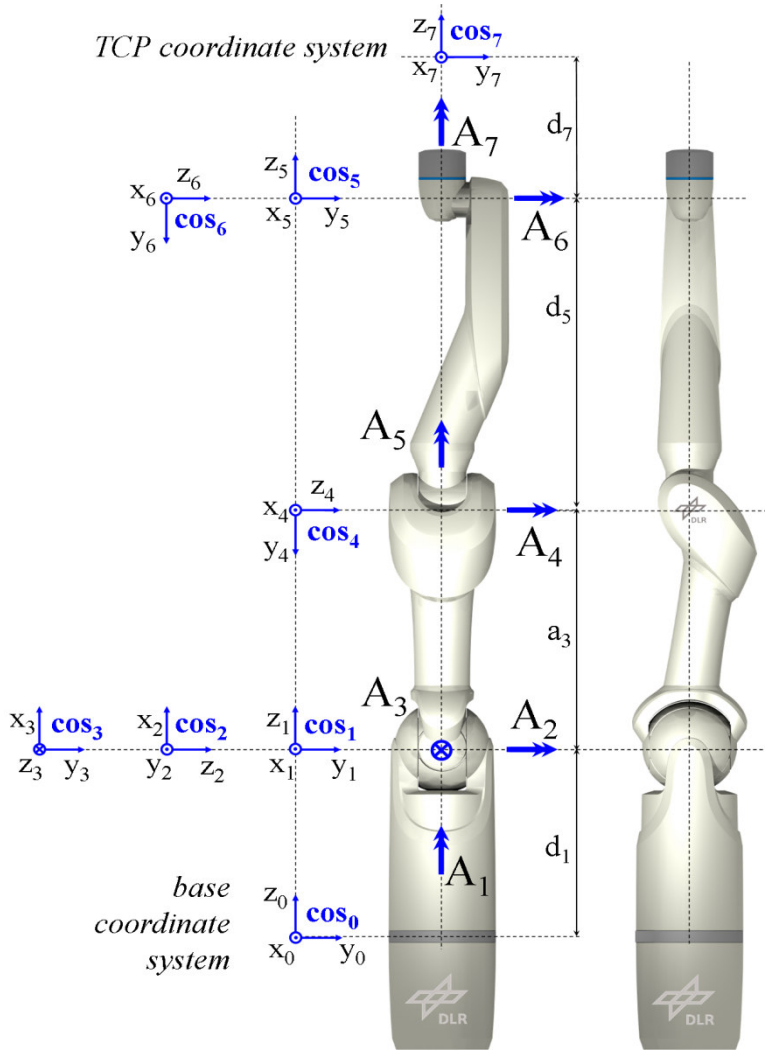


Specialized and Versatile Systems



The MIRO – a versatile medical robot

- Compact and redundant
  - 7 degrees of freedom
  - Coupled joints
  - Kinematic length 760 mm
- Light weight
  - Weight < 10 kg
  - Payload 30N
- Torque sensors in all joints
- Fast Space wire communication



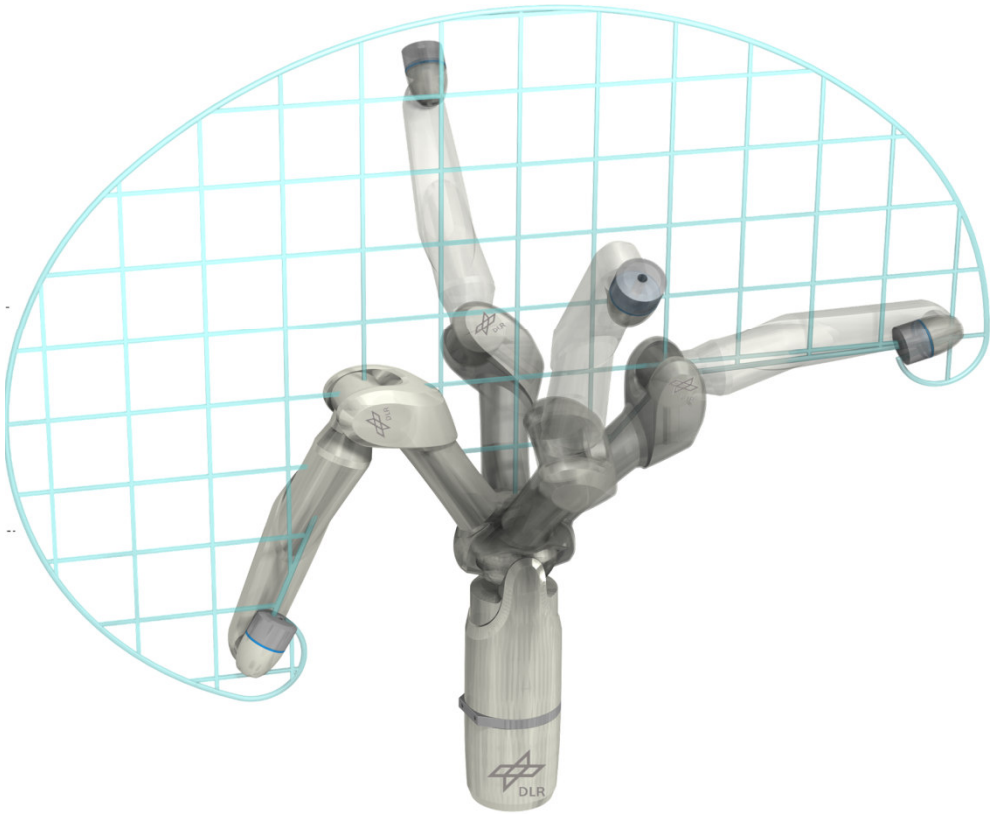
MIRO Features

Safe interaction

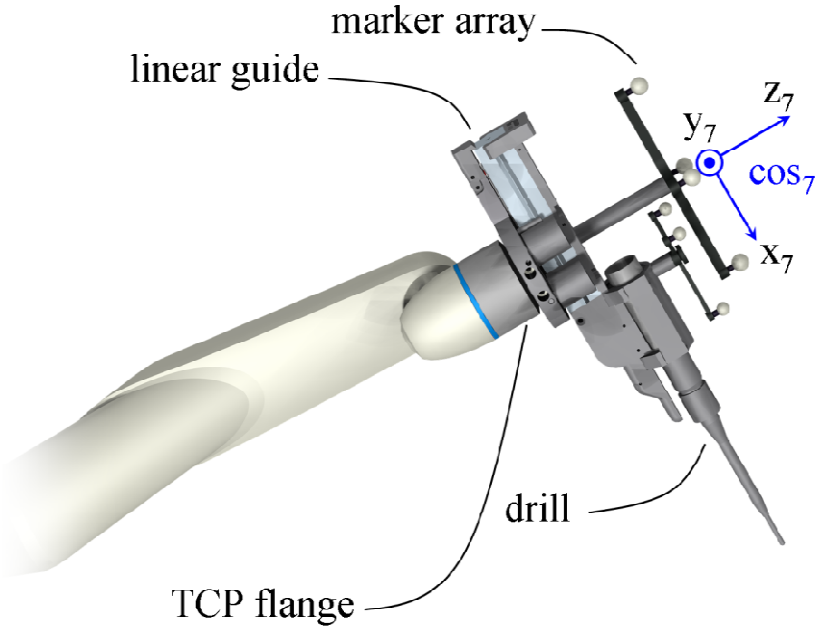
- Reduced mass
- Compliant control

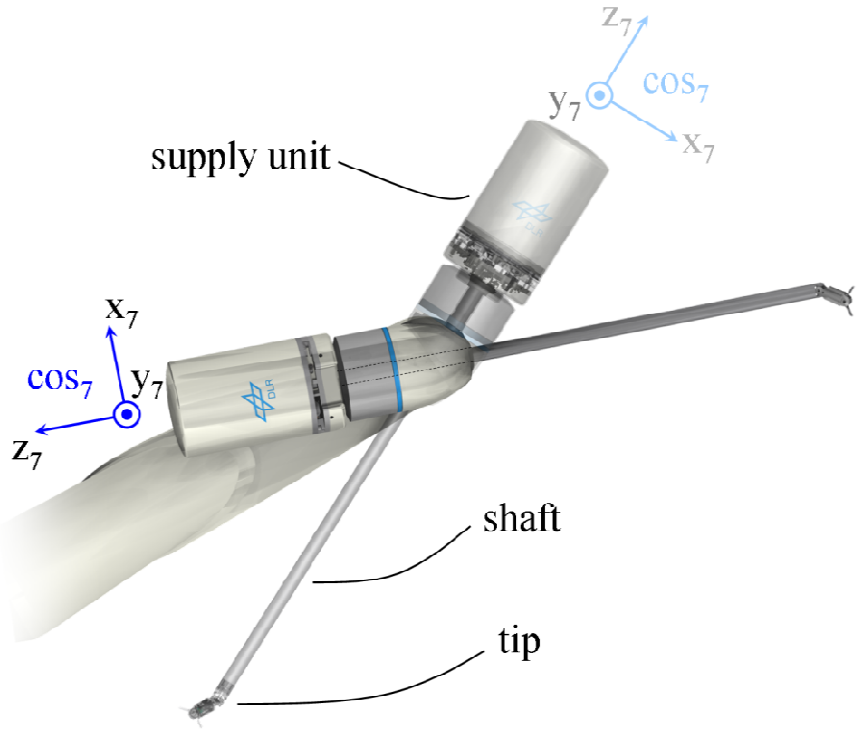
Adaptable and flexible

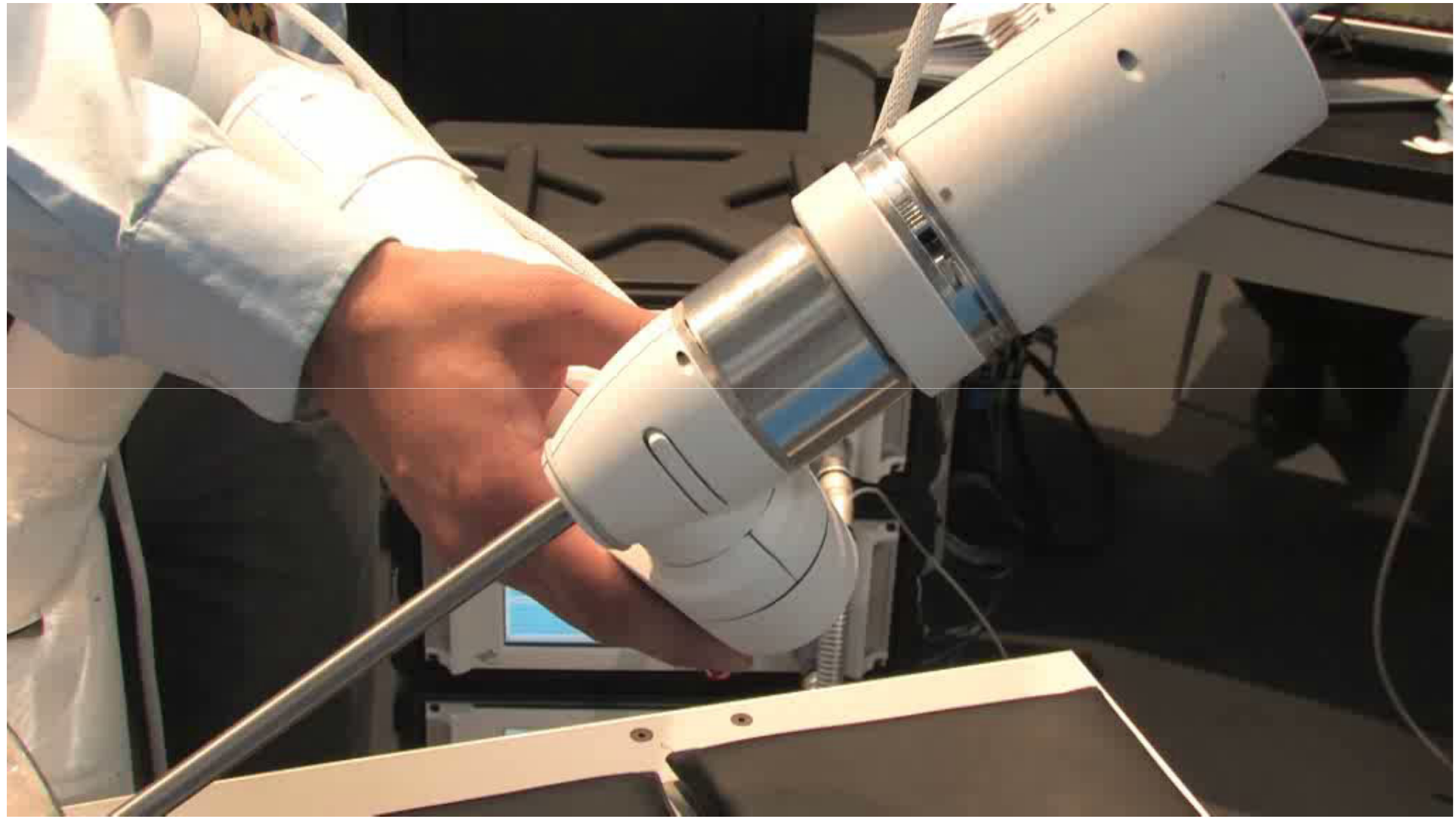
- Magnetic instrument interface
- Kinematic redundancy
- Accurate position control
- Compliant impedance control
- Torque control



Versatile Instrument Interface

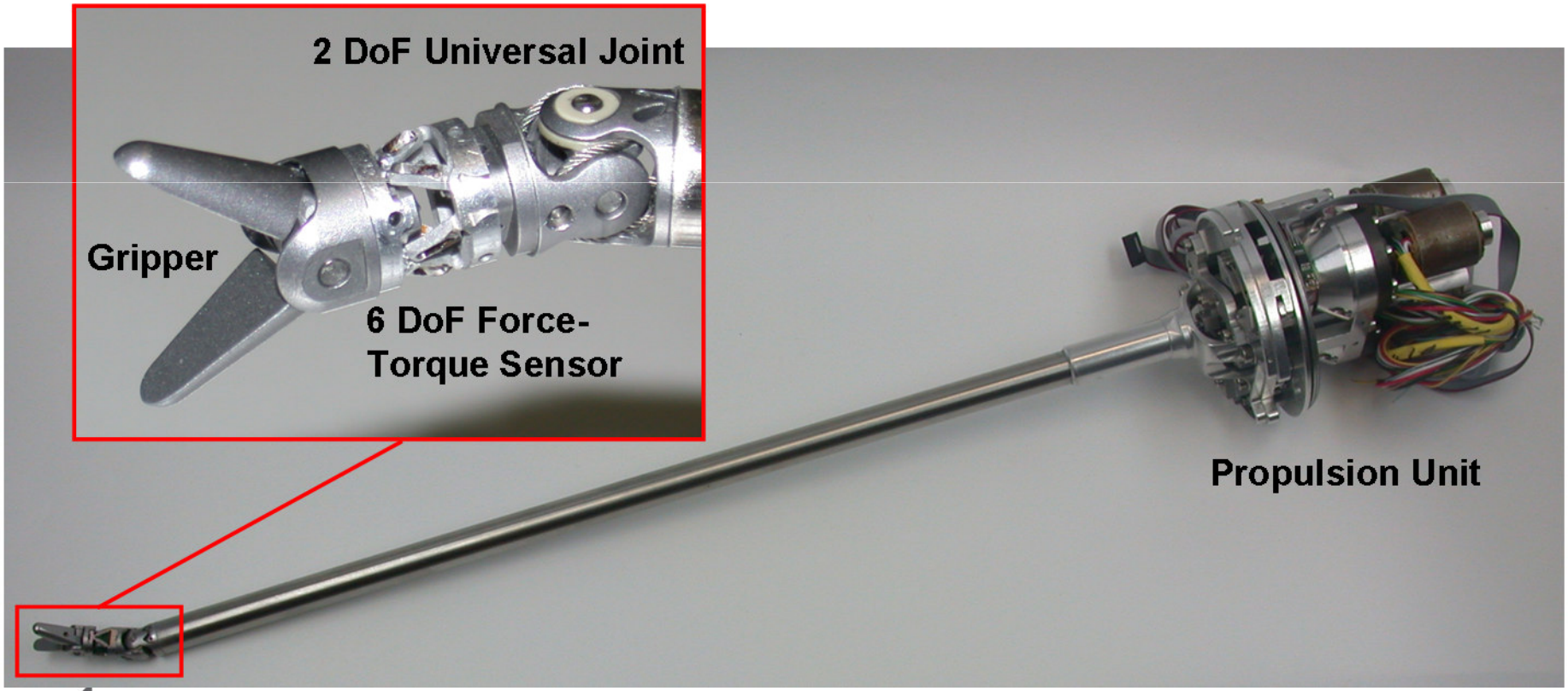


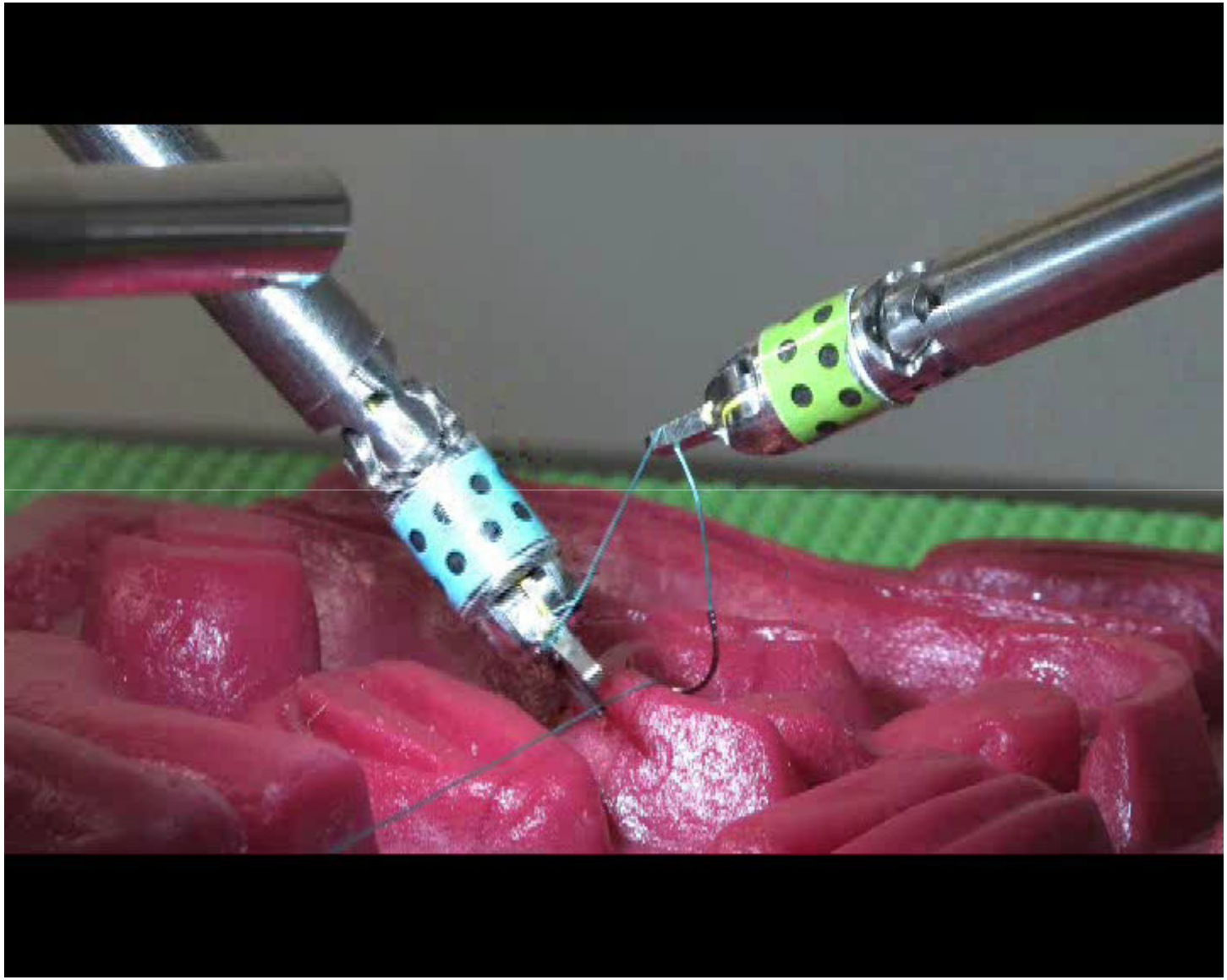




Instrument for MIRS

- Full dexterity inside the patient
- Sensing of manipulation forces/torques
- Surgical gripper with force sensor





Surgeon‘s Workstation for MIRS

Bimanual force feedback

- Haptic device Omega.7
- Forces and grasping are displayed

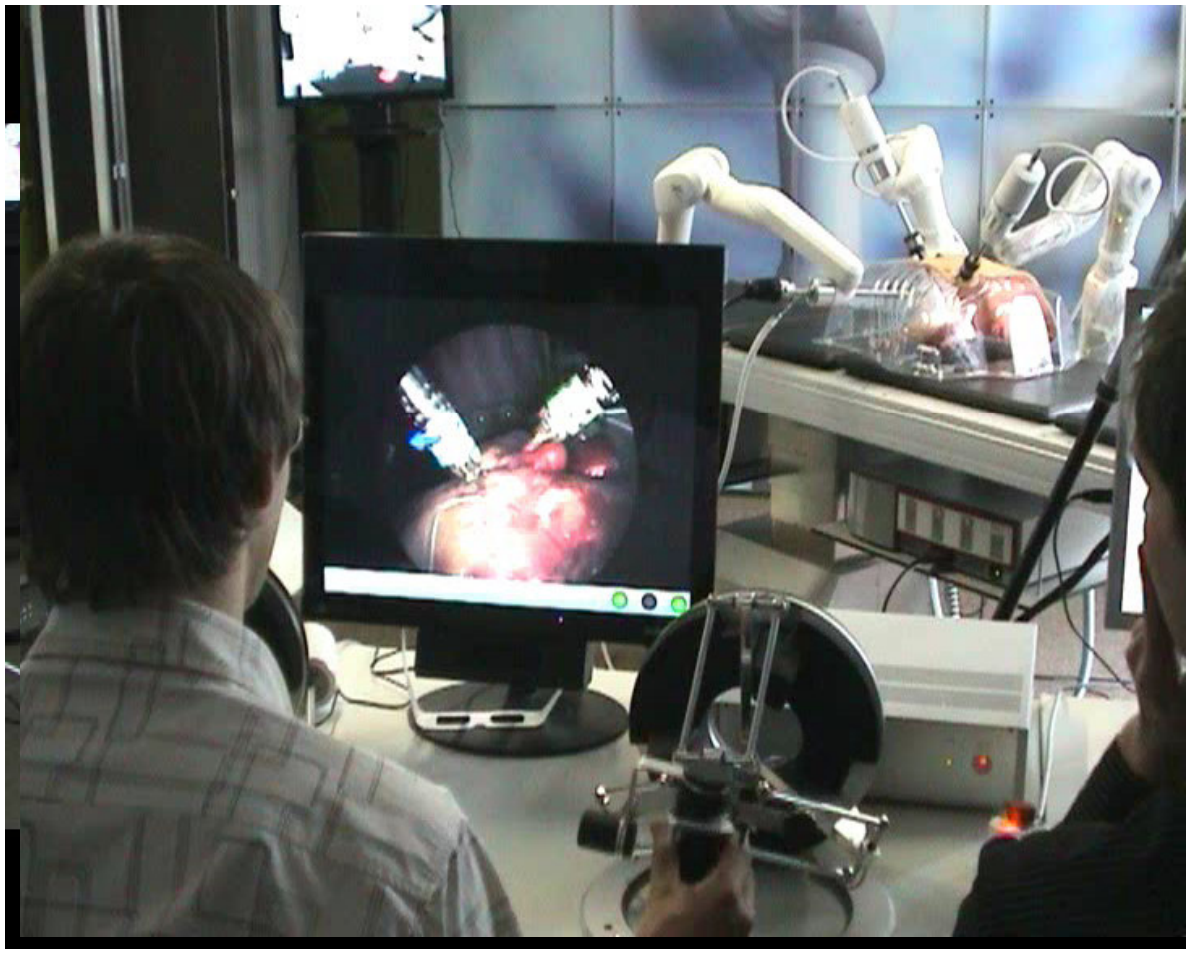
Stereo vision

- Autostereoscopic display
- Eye-tracking
- Augmented reality

Image stream via ethernet

- Video server
- Various receiving clients

Control by optically tracked forceps



Conclusions

The MIRO, a versatile medical robot

- Light weight and redundant
- Compliant control

The DLR instrument for MIRS

- Full dexterity inside patient
- Sensing of manipulation forces

Robot setup planning

- Preoperative planning
- Intraoperative adaption to OR

Surgeon workstation

- Force feedback
- Stereo vision

Real time control

- Flexible configuration of components
- Simple interface for surgeon