ÓBUDA UNIVERSITY

EKIK – UNIVERSITY RESEARCH AND INNOVATION CENTER

Pro Scientia et Futuro!

Translational research at Óbuda University

Tamás Haidegger, PhD

Óbuda University (OU),
Austrian Center for Medical Innovation and Technology (ACMIT)

EKIK

ÓBUDA UNIVERSITY

EKIK – UNIVERSITY RESEARCH AND INNOVATION CENTER

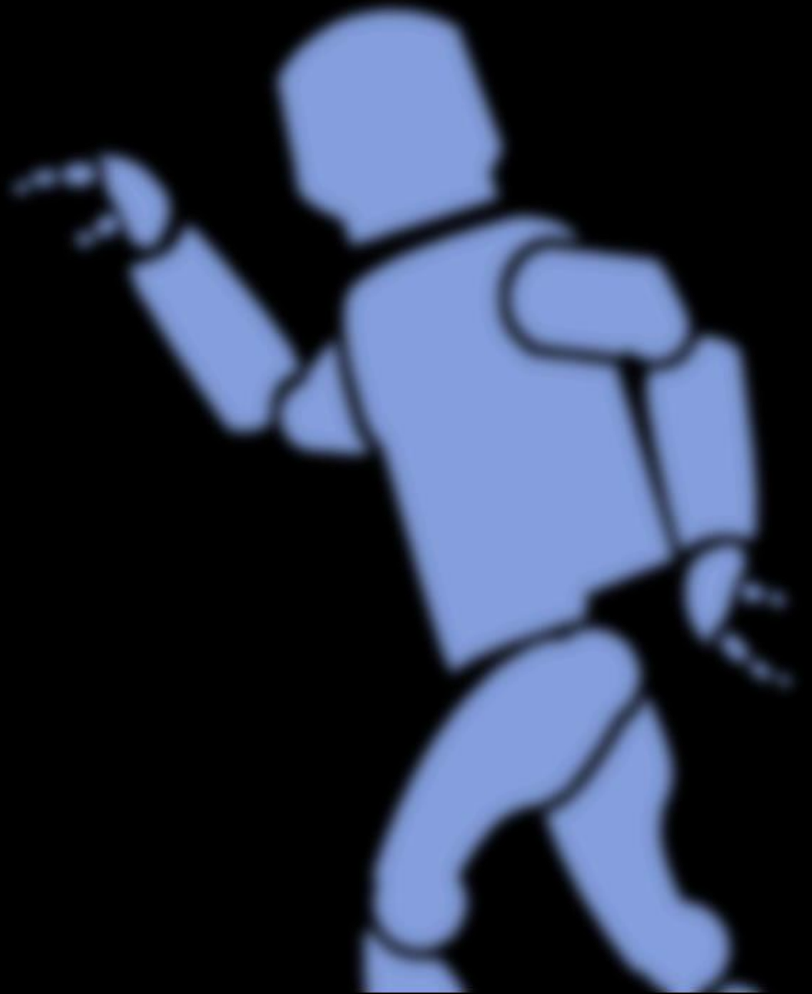
Main goals

- Participation in high-end international R&D projects
- Managing university projects and R&D focused education
- Building a strong international network
- Publication of world class research results
- Innovation Ecosystem management
- University Venture Capital activities

Centers of EKIK

Active research centers

- **Antal Bejczy Center for Intelligent Robotics**
- **Bio-Tech Research Center**
- **Physiological Controls Research Center**
- Health Economics Research Center
- Hydro-Bio-Mechanical Systems Research Center
- SmartLab Center
- Alternative Energy Sources Research Center
- Electric Power Conversion Systems Research Center



ÓBUDA UNIVERSITY
IROB – ANTAL BEJCZY CENTER FOR INTELLIGENT ROBOTICS

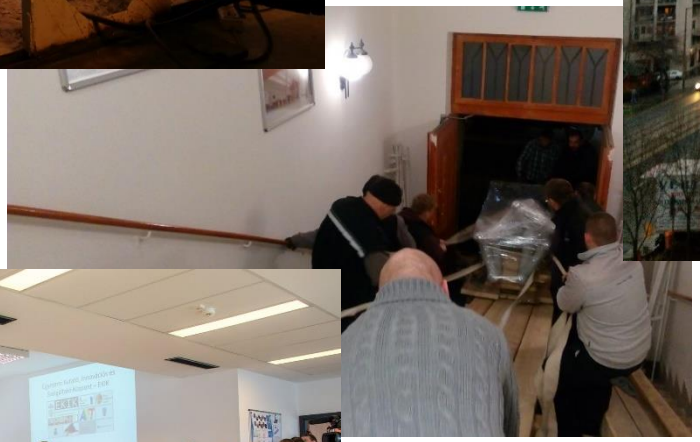
ÓBUDA UNIVERSITY
EKIK - UNIVERSITY RESEARCH AND INNOVATION CENTER

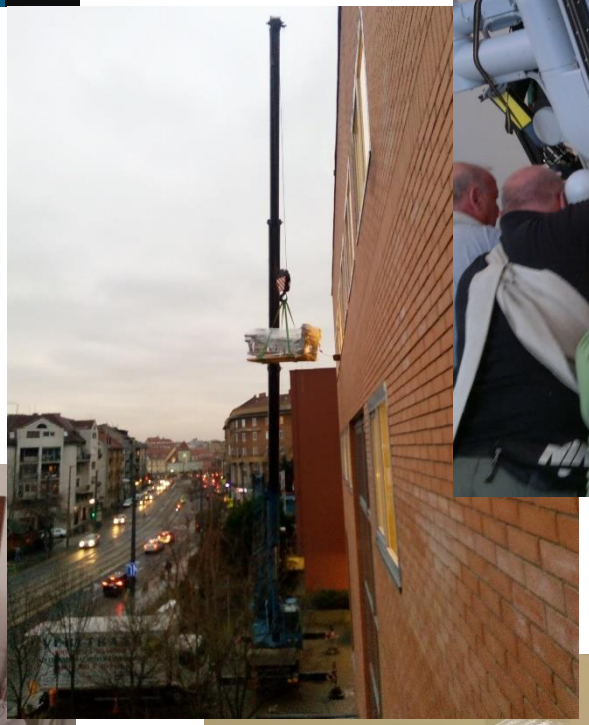
Antal Bejczy Center for Intelligent Robotics (IROB)

http://irob.uni-obuda.hu/

Director: Dr. Péter Galambos

Moving in…

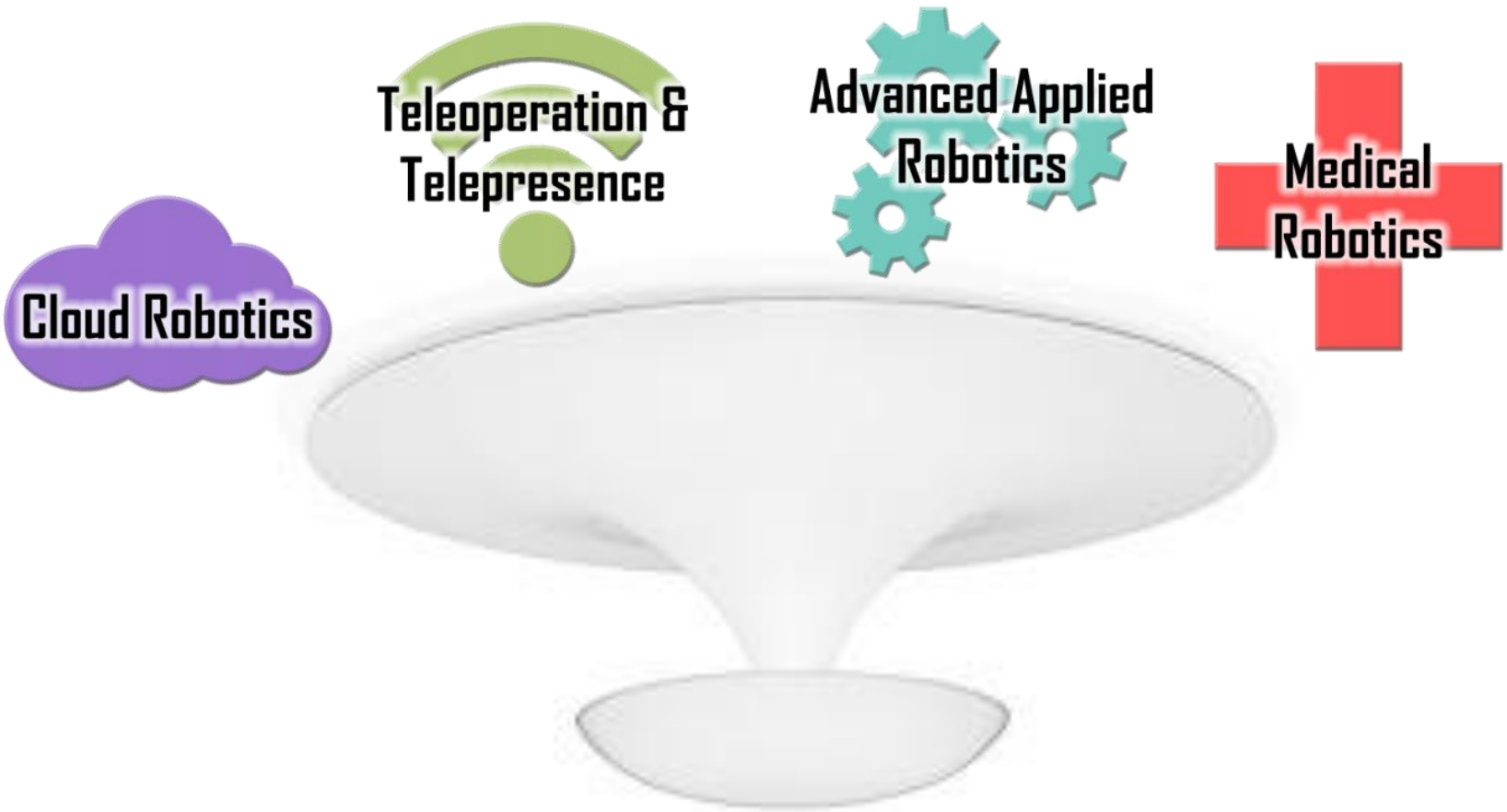




In memoriam Antal K. Bejczy

- Senior Engineer at NASA JPL
  - PI of the RAMS eye surgery robot project
- Professor at Caltech
- Founder of IEEE RAS
- Honorary Professor of Óbuda University

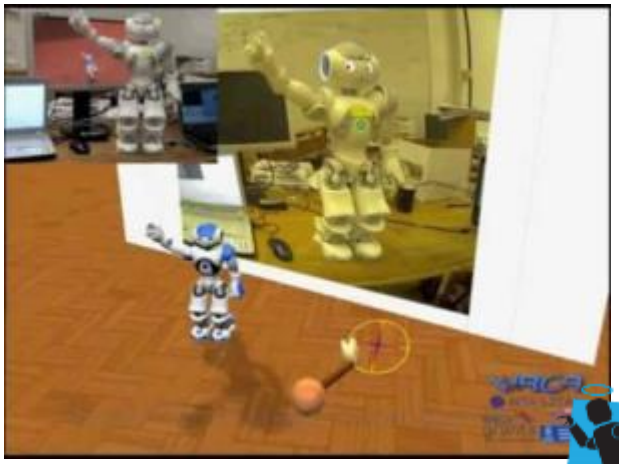
Research domains



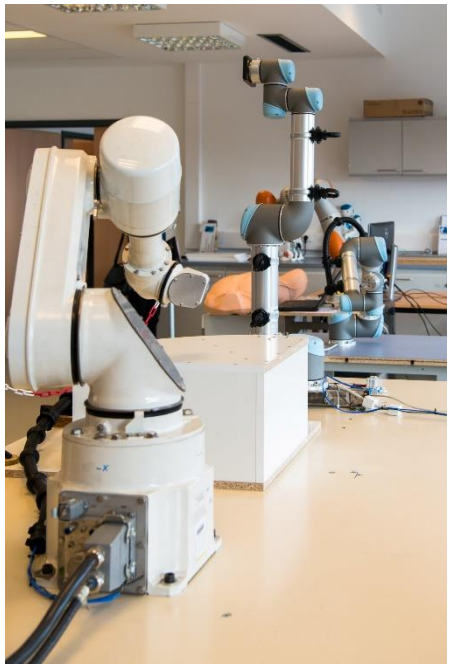
Industrial & Medical Cyber-Physical Systems

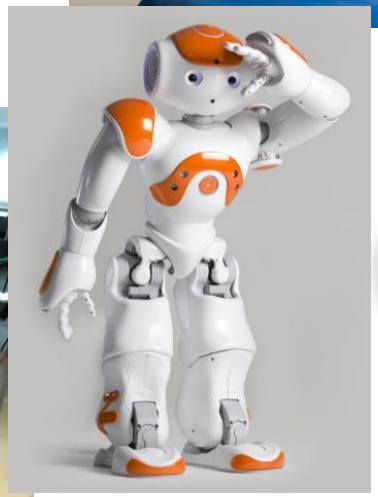
R&D projects

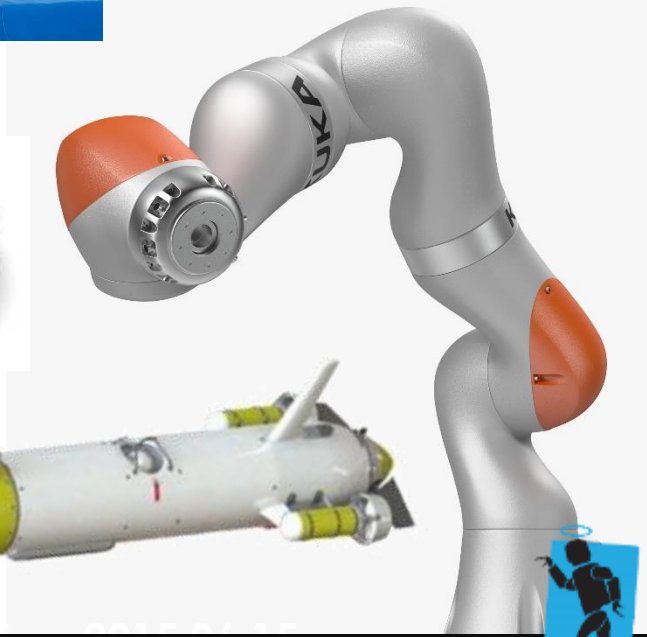
- Haptic feedback and teleoperation (KUKA YouBot)
- Human-robot interaction, social robotics (NAO robots)
- Hardware in the loop simulation of processes (Fanuc & VirCa)
- Adaptive control without model (RFPT method)
- Underwater navigation and mapping (Sparus II robot)
- Model-based surgical robotics (DVRK)



Robot infrastructure

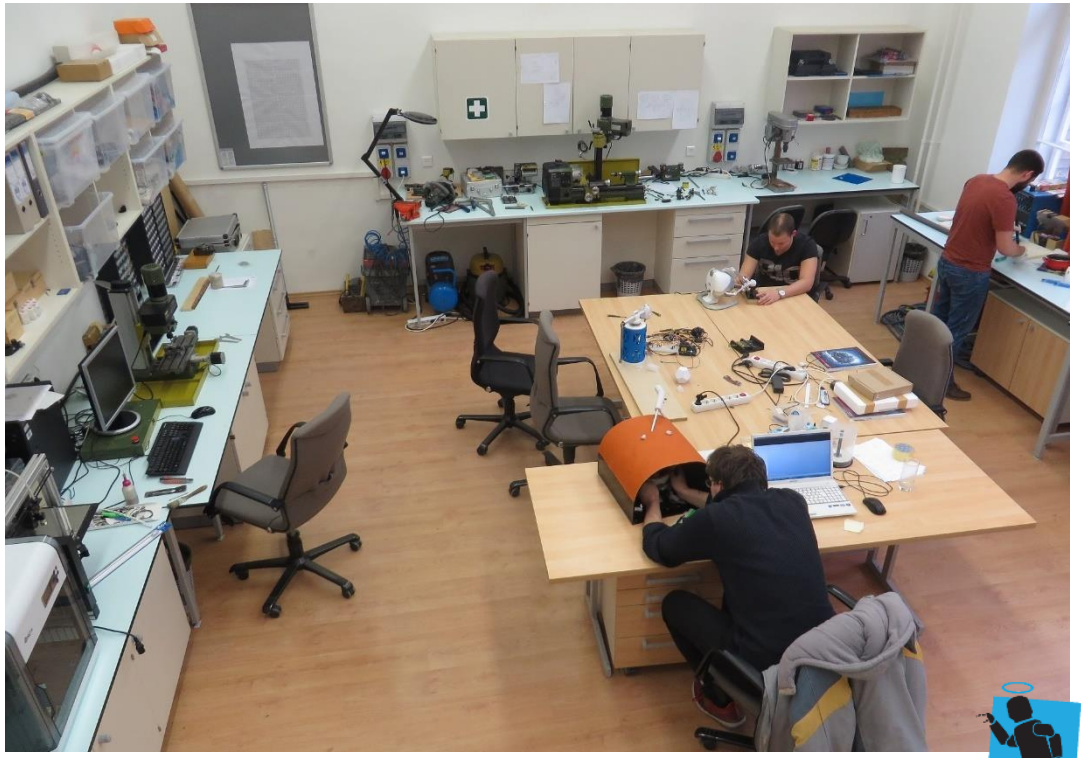






MakerSpace @ iROB

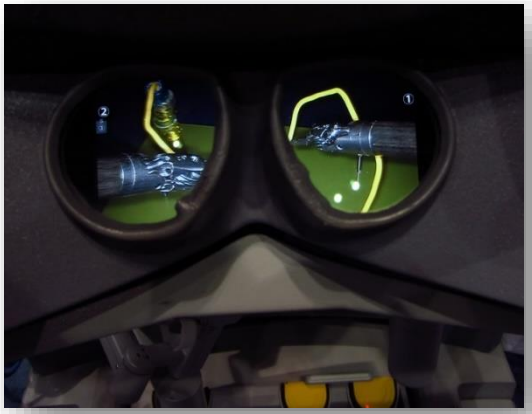
- **Open workshop** for all innovation-minded creators
- Great inventory of **tools and equipments**
- Metal cutting
- 3D printing
- Plastic molding
- Electronics prototyping
- Full engineering support

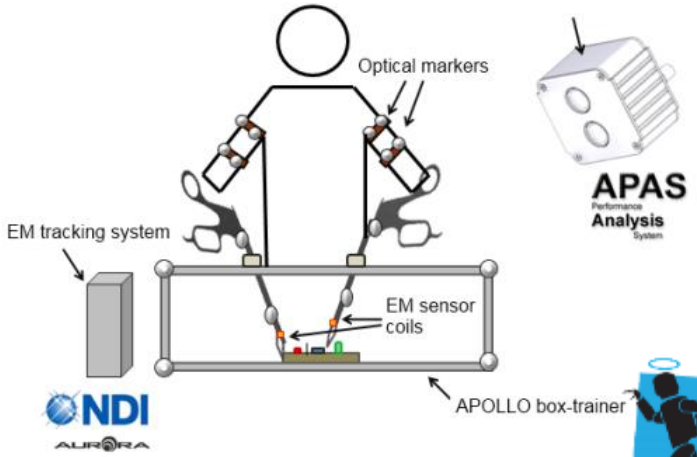


Computer-Integrated Surgery R&D

Research interests

- Surgical skill assessment
  - Learning curve assessment
  - Teleoperation under latency
  - TDS control algorithms
- Surgical Process Modelling
  - Procedure-based approach
  - Surgical ontologies
- MES MEE standardization
  - ISO/IEC safety standards
  - IEEE RAS ORA
  - Working with notified bodies for future test methods

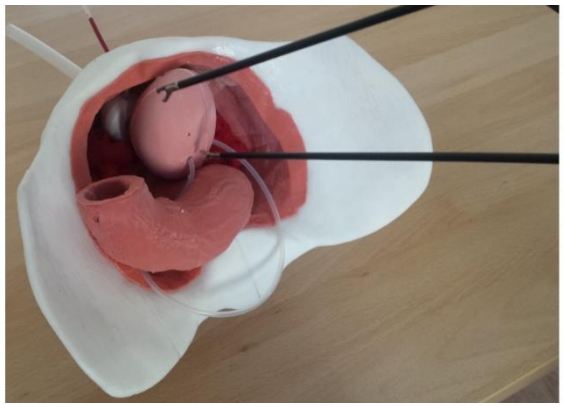




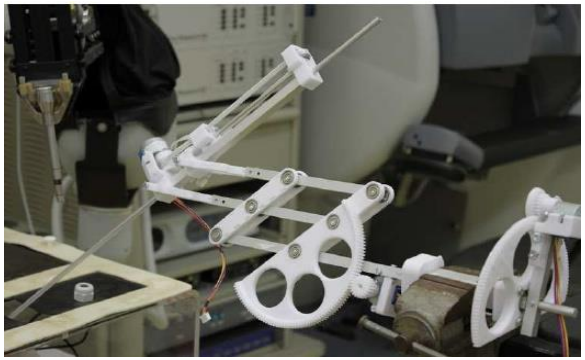
Improvements for MIS training

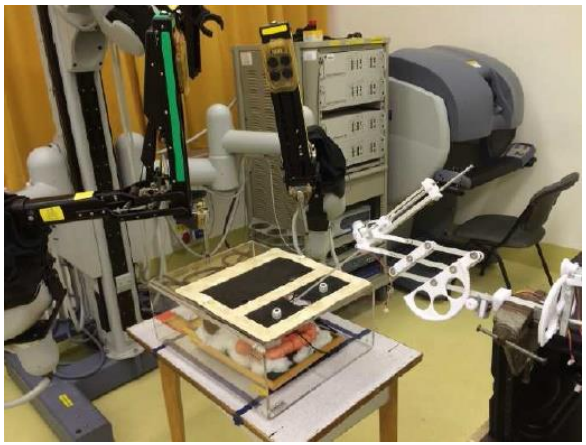
Research projects

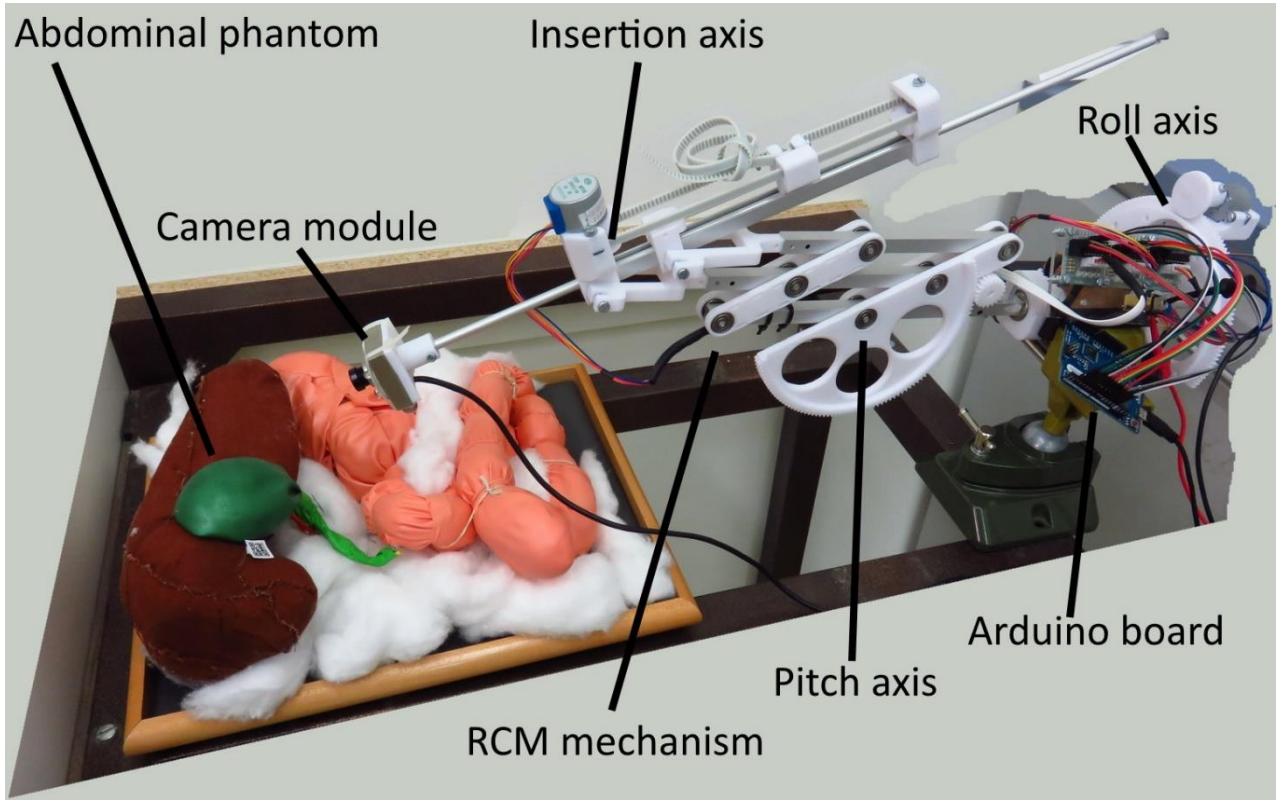
- Surgical skill assessment and surgical intern education for camera handling
- Designing, building and testing of a camera holding robotic arm
- Focusing on lightweight and low-cost design
- Creating a realistic phantom environment for surgical interventions



Calap: Computer-Assisted Laparoscopy trainer







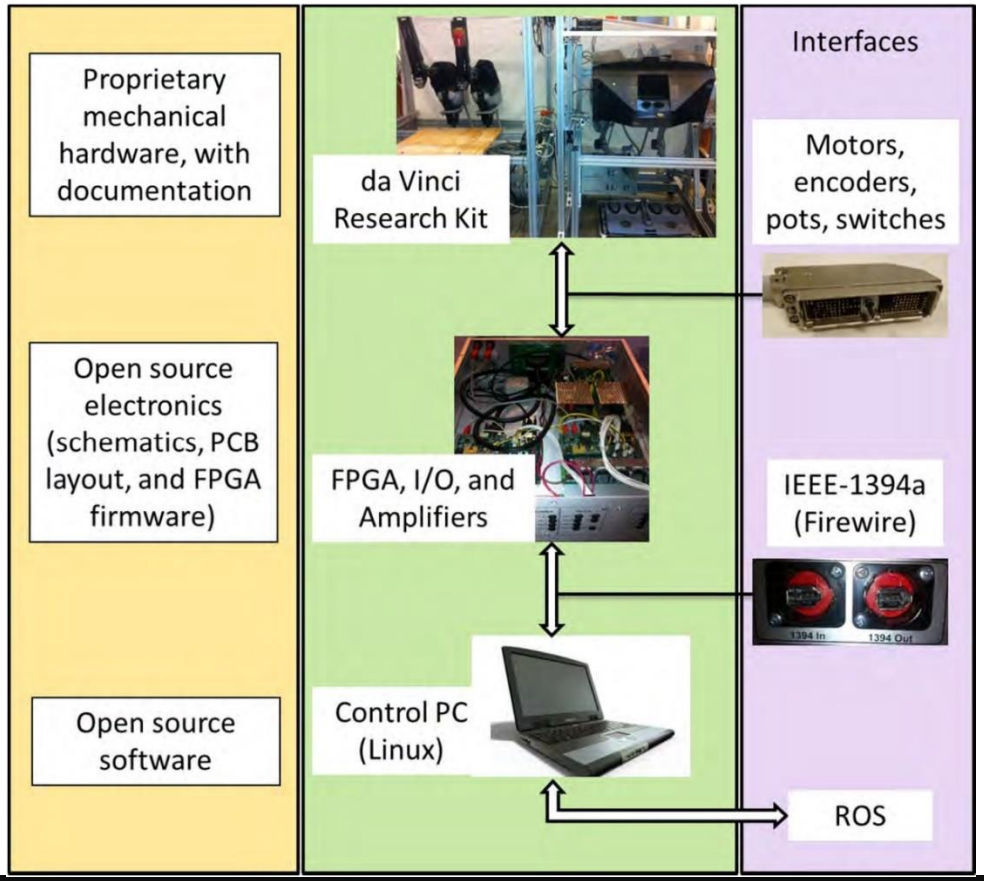
Credit: Nagy et al.

Surgical robotics at IROB

Da Vinci Surgical System Research Kit (DVRK)

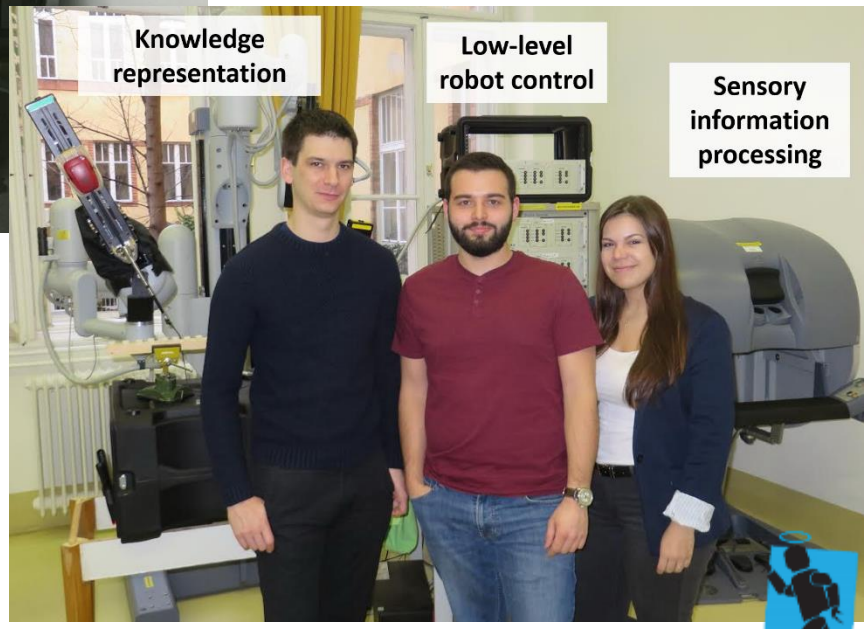
Surgical Assistant Workstation (SAW)

- Developed by the Johns Hopkins University and WPI
- Research was founded by the National Science Foundation (NSF)



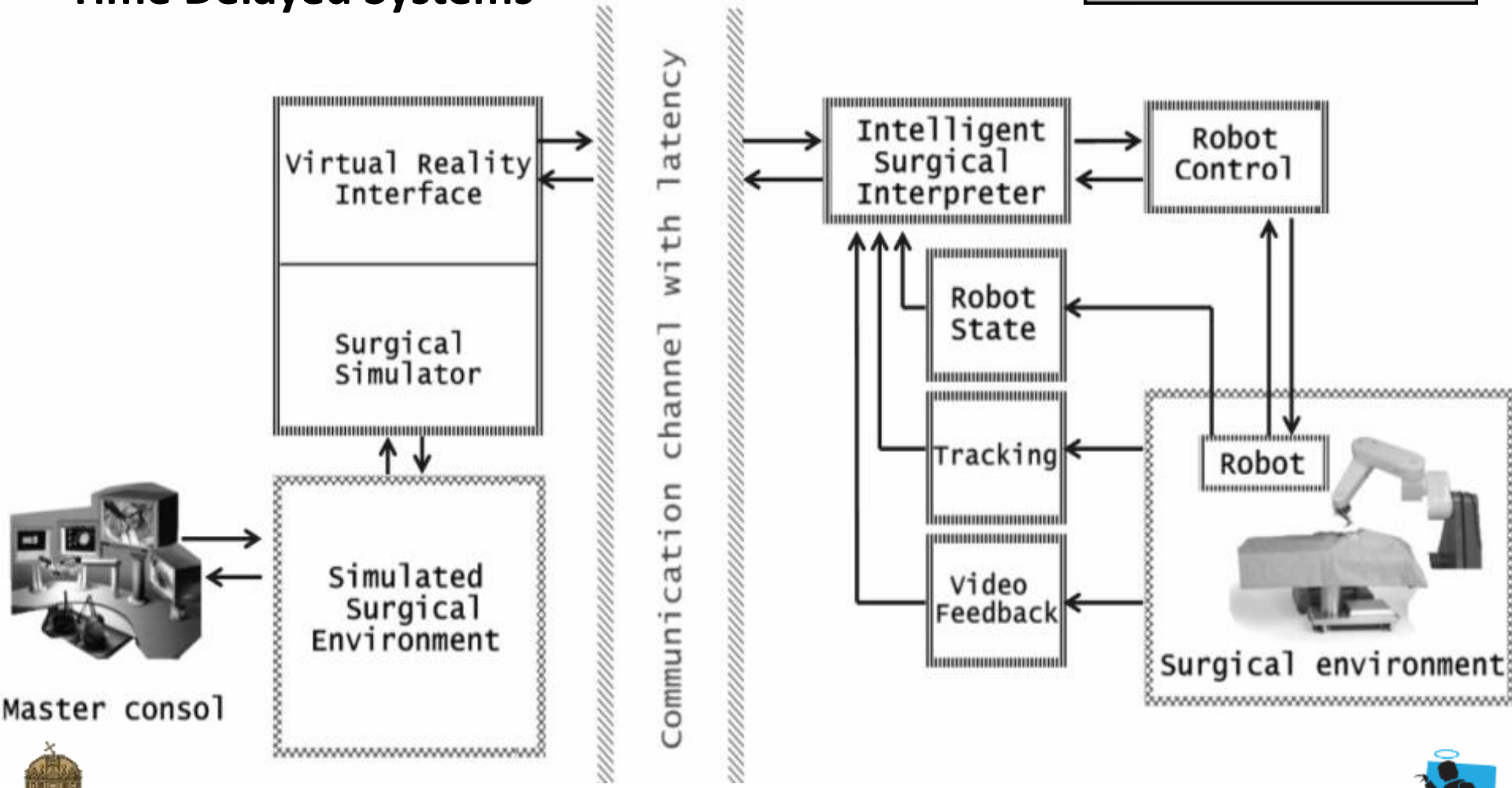
Surgical robotics research

2014-15: Da Vinci Surgical System Research Kit



Teleoperation control

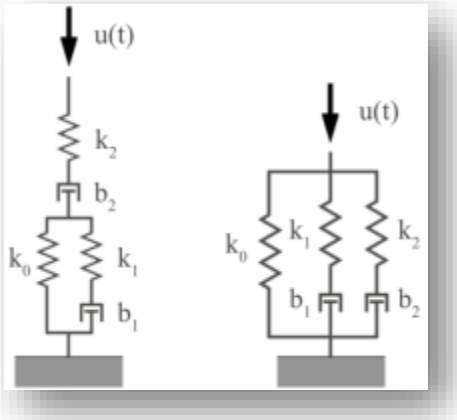
Time Delayed Systems

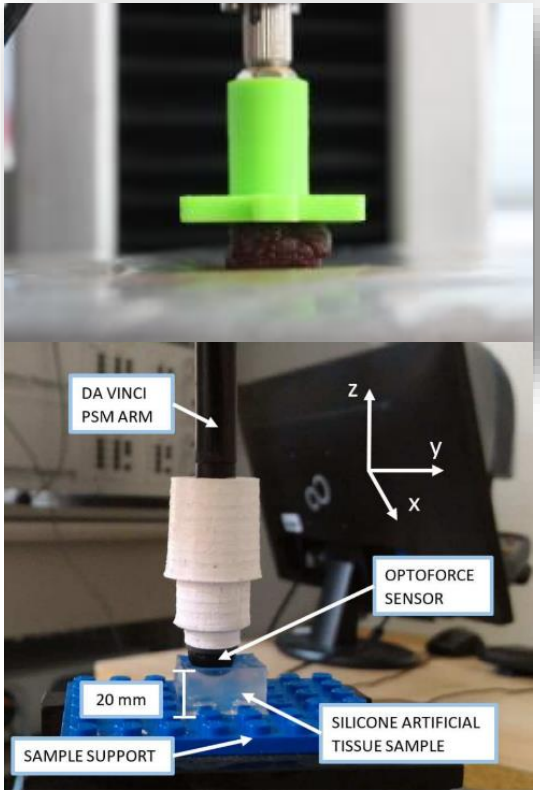


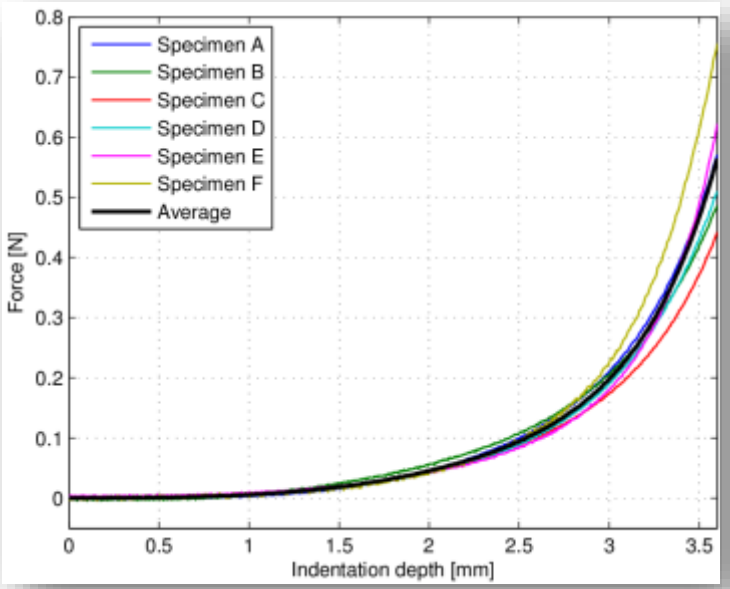
Investigation of nonlinear tissue models in robotic applications

Research tasks

- Analyzing soft tissue behavior under manipulation tasks
- Creating a mechanical model for soft tissues and tool–tissue interaction
- Model verification and parameter estimation by curve fitting
- Implementation of model-based force control for time-delayed robotic systems



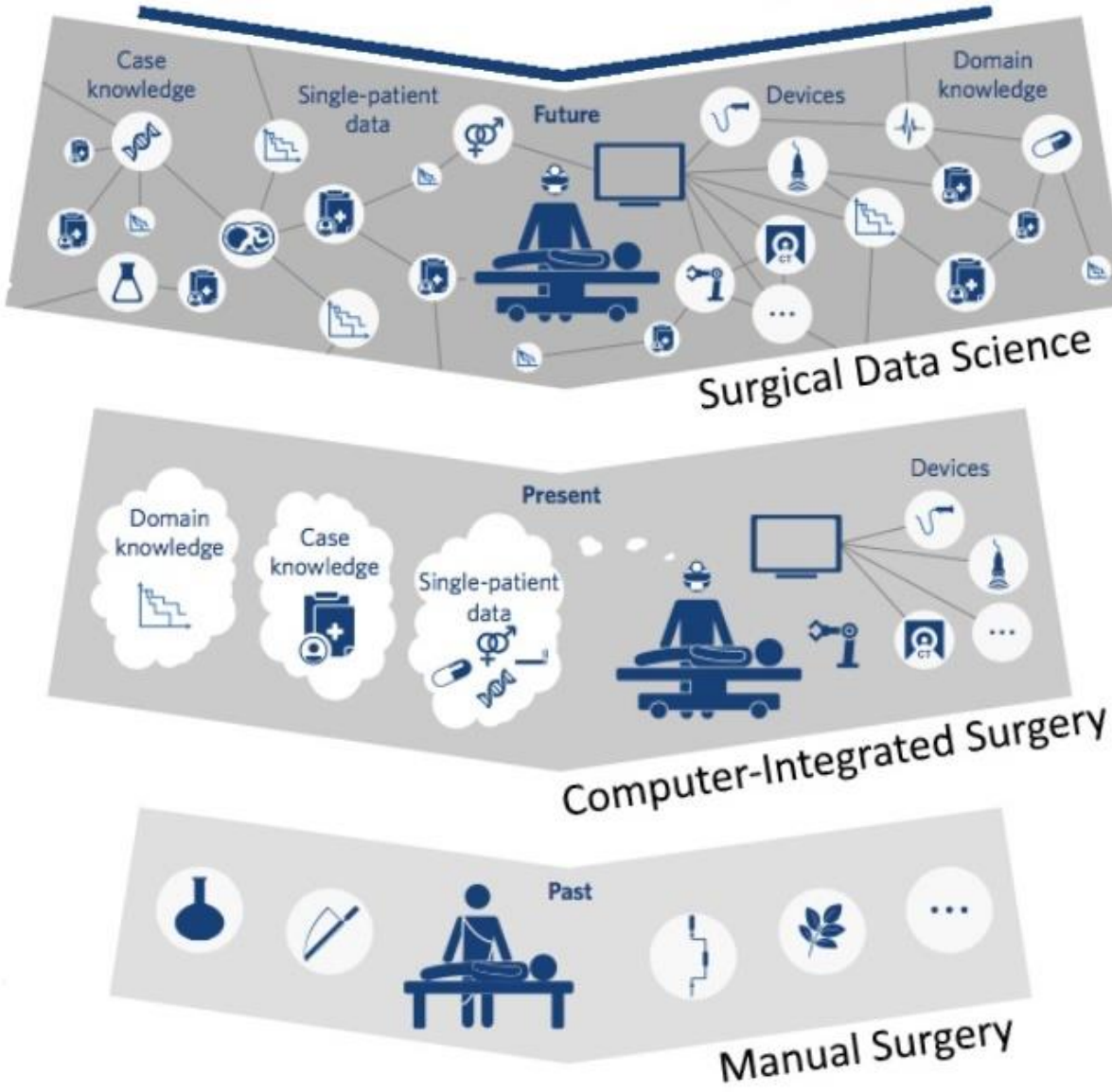




Credit: Takács et al.

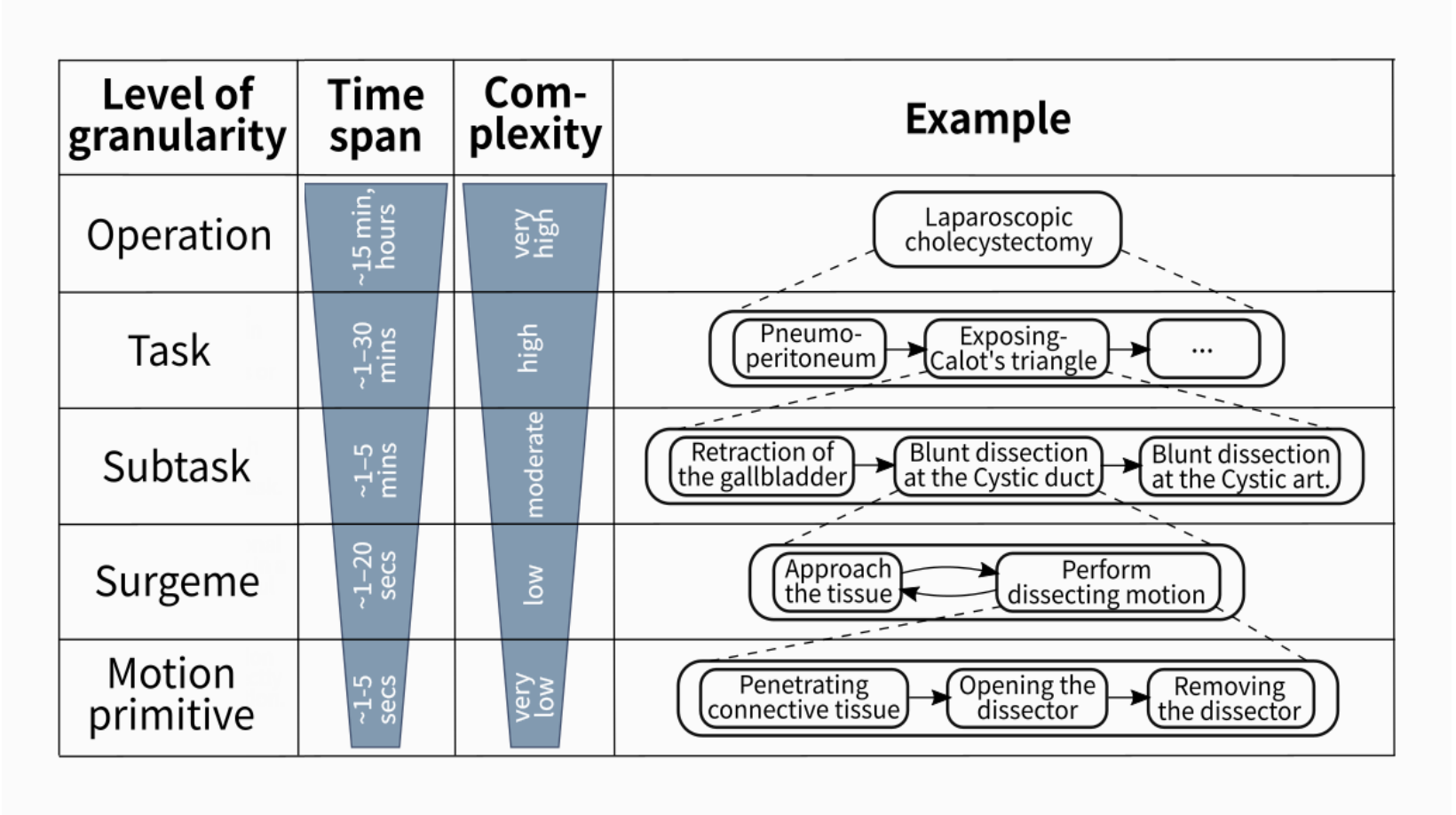
Surgical Data Science (SDS)

Surgical ontolgies
Surgical Process Modelling



Maier-Hein et al., Nature BE, 2017, https://arxiv.org/abs/1701.06482

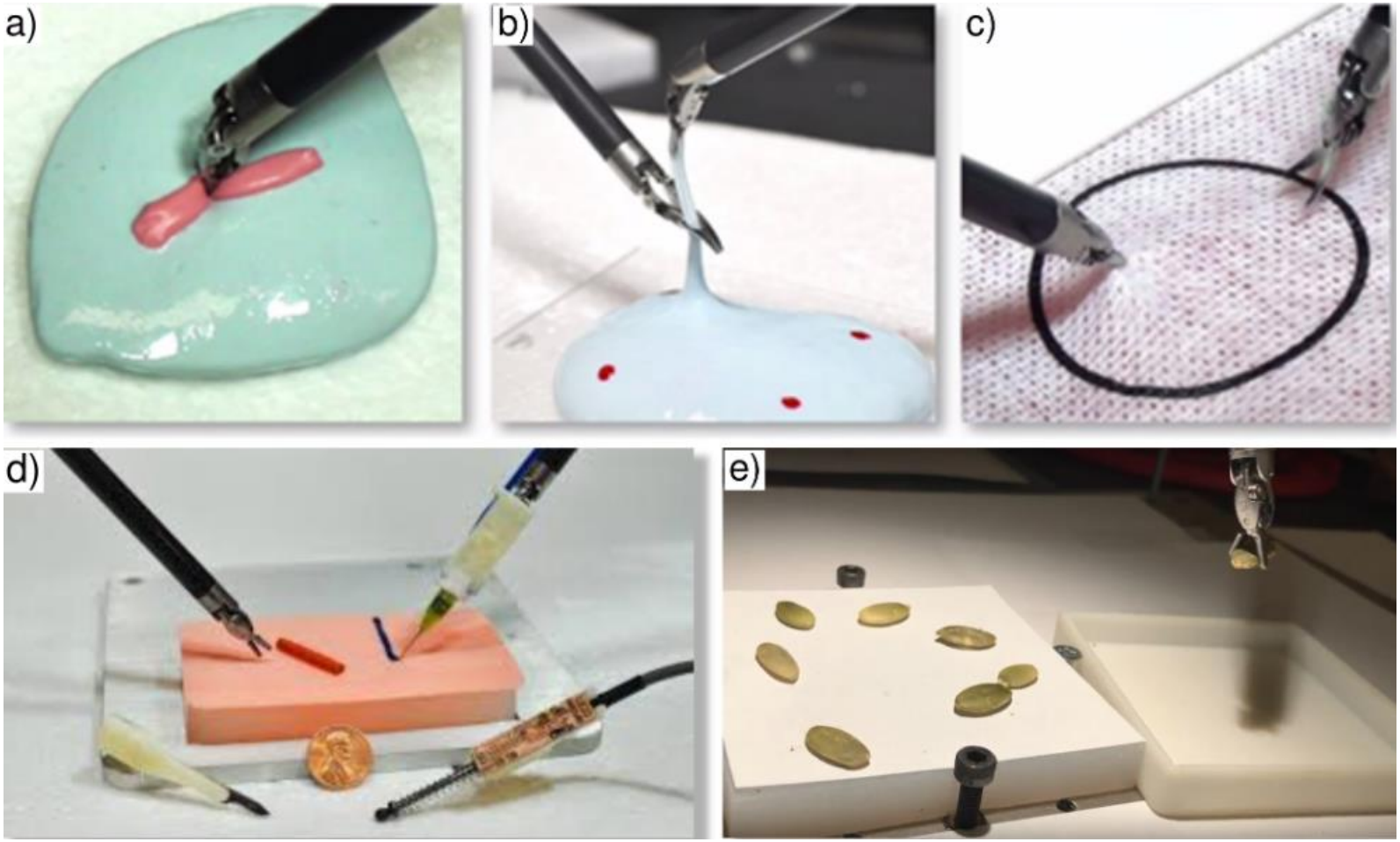
Surgical Data Science (SDS)



Gibaud B, Forestier G, Feldmann C, et al. Toward a standard ontology of surgical process models. Int J CARS. 2019;13:1397–1408.

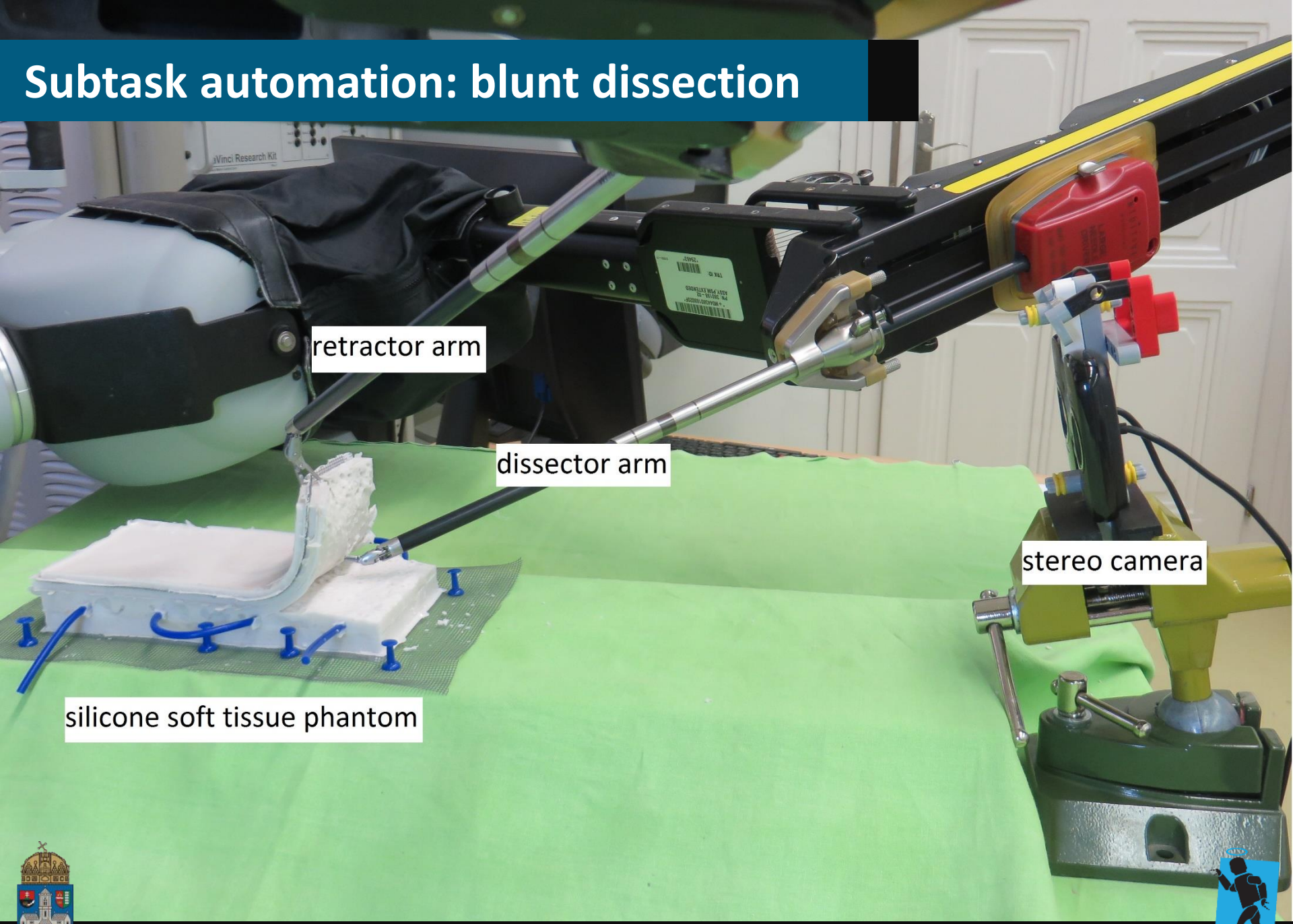
Nagy T, Haidegger T., A DVRK-based Framework for Surgical Subtask Automation, Acta Polytechnica Hungarica, v. 17, no 3, 2019.

Subtasks ready for automation



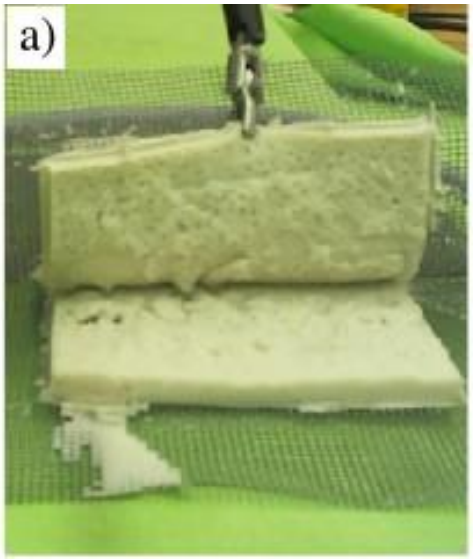
Nagy et al., APH, 2019, https://uni-obuda.hu/journal/Nagy_Haidegger_95.pdf

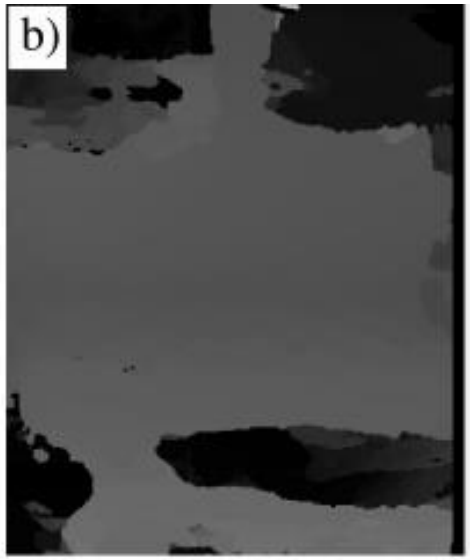
Subtask automation: blunt dissection

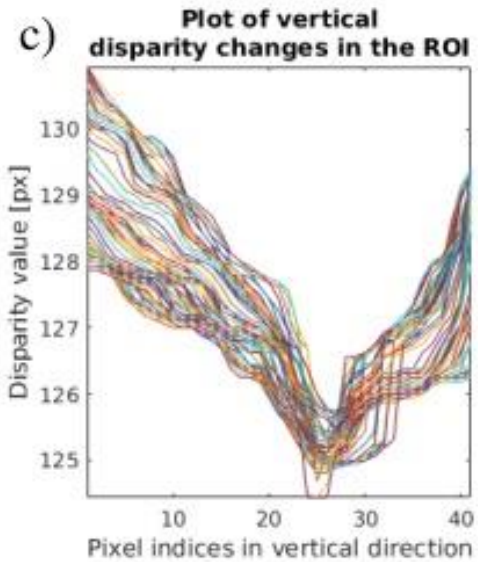


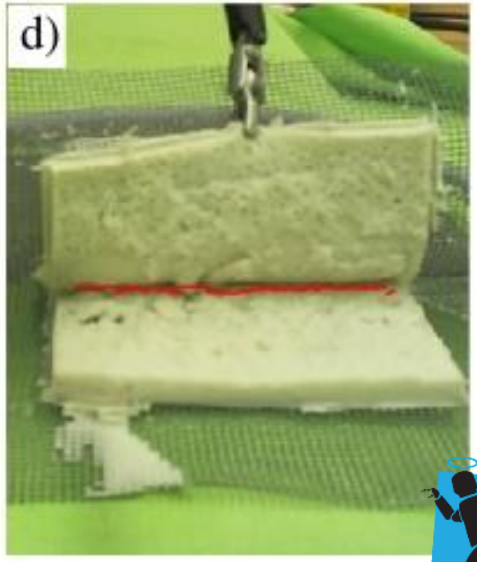
Dissection line detection

- Stereo camera calibration
- Disparity map
- Initialization
- Local minima
- Segmentation

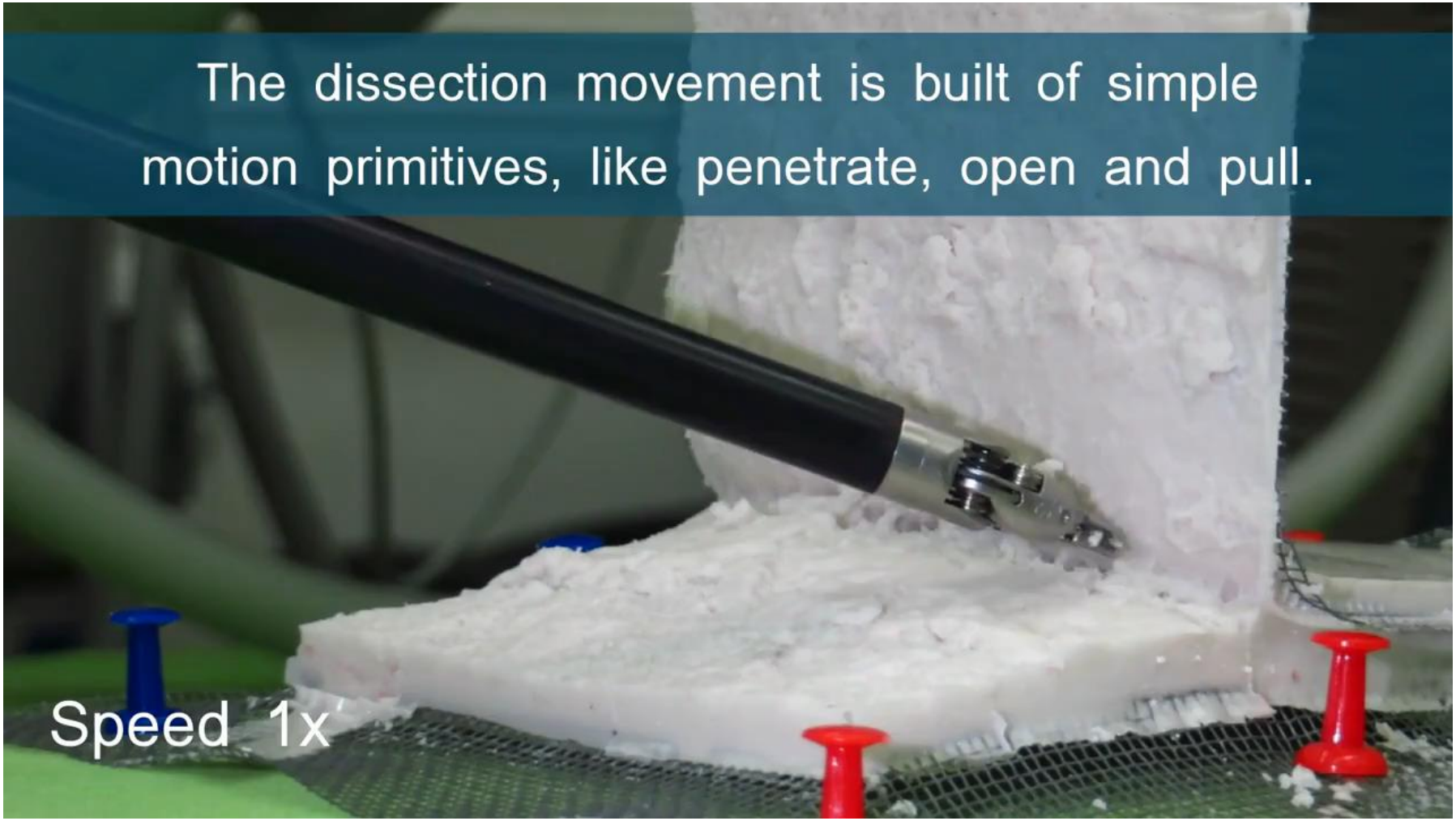




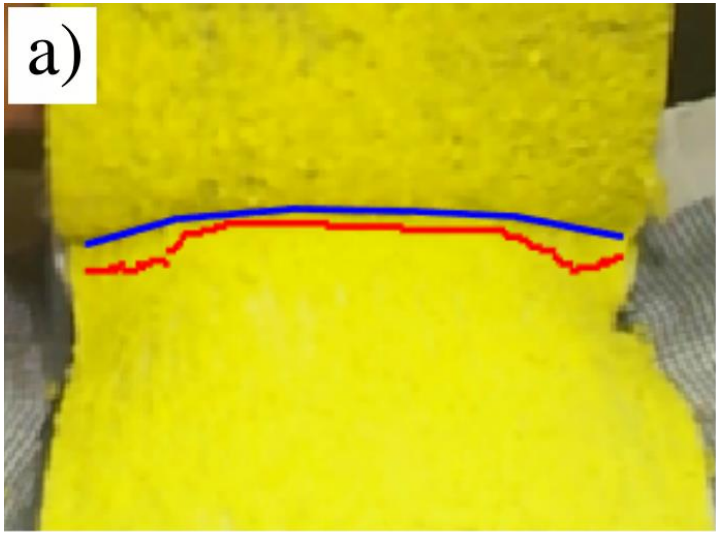


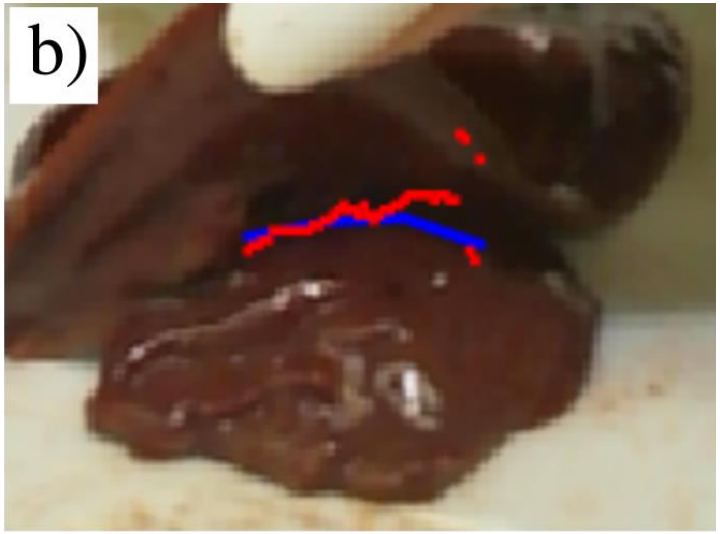


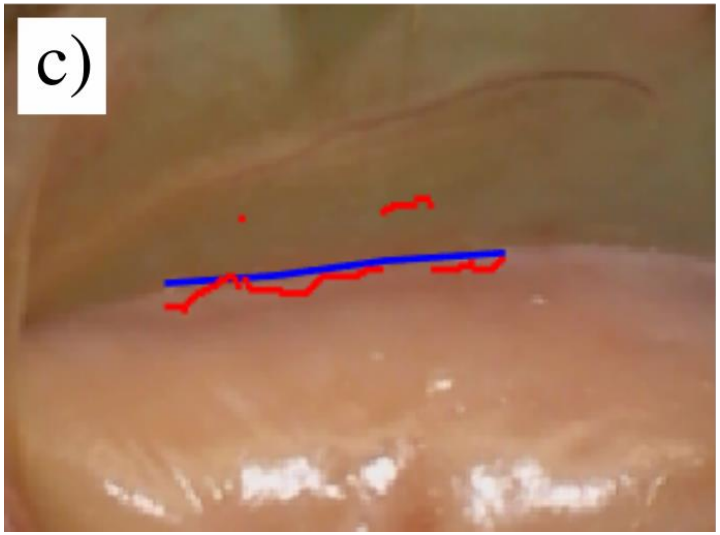
Video – automated blunt dissection

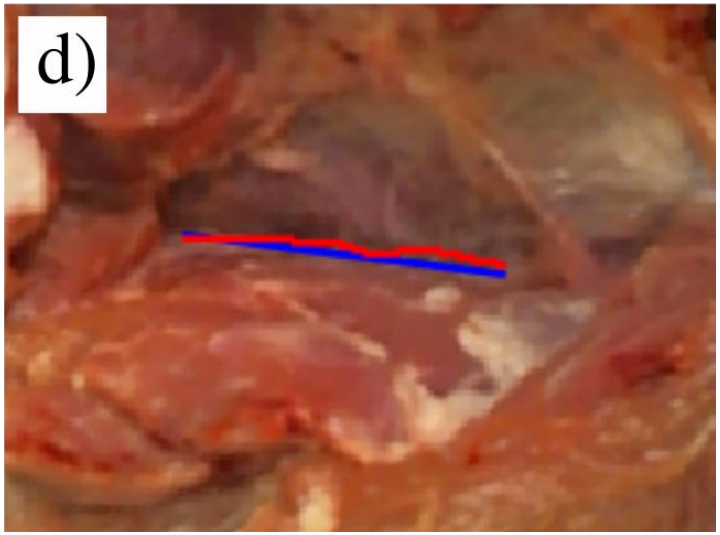


Accuracy of the system

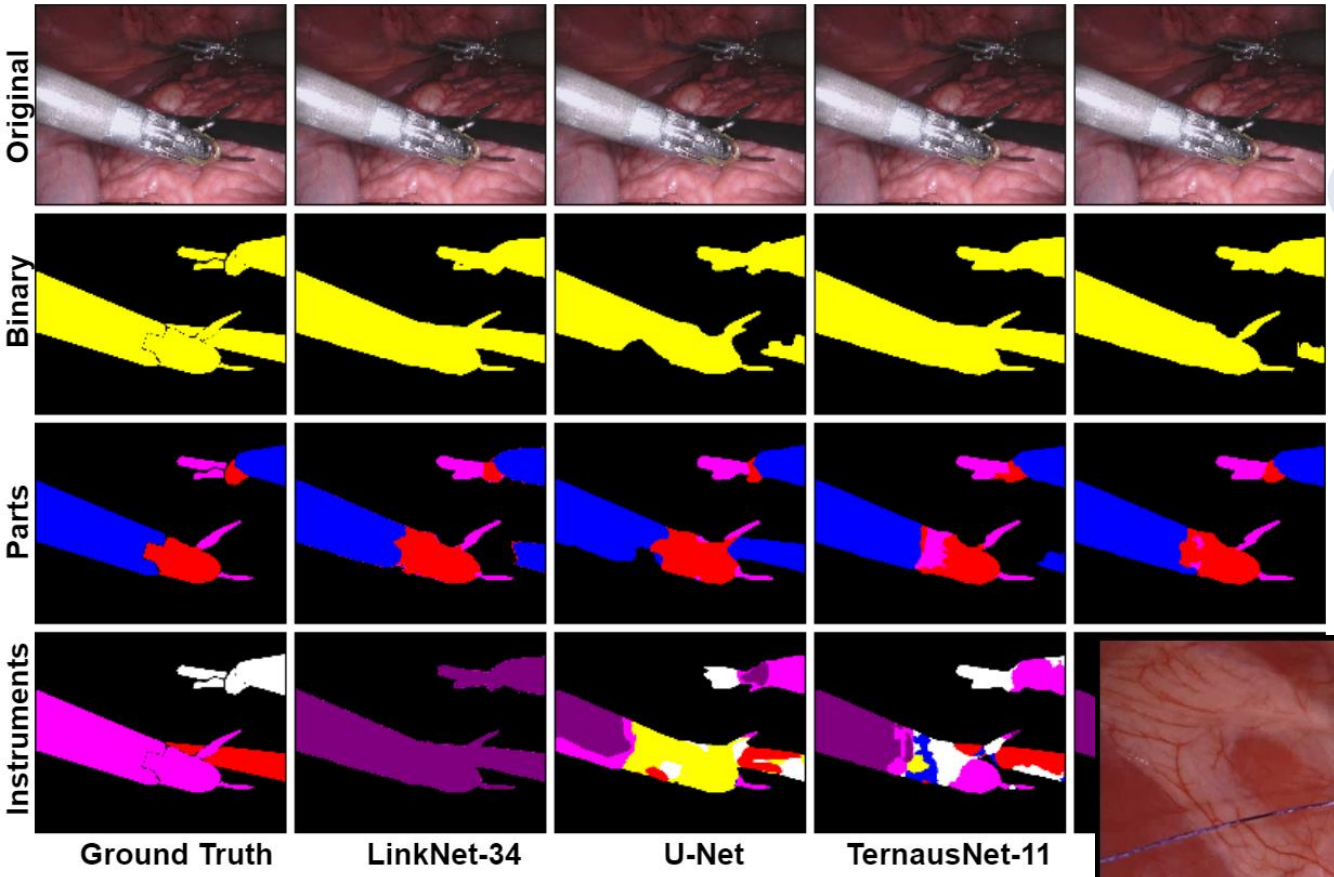


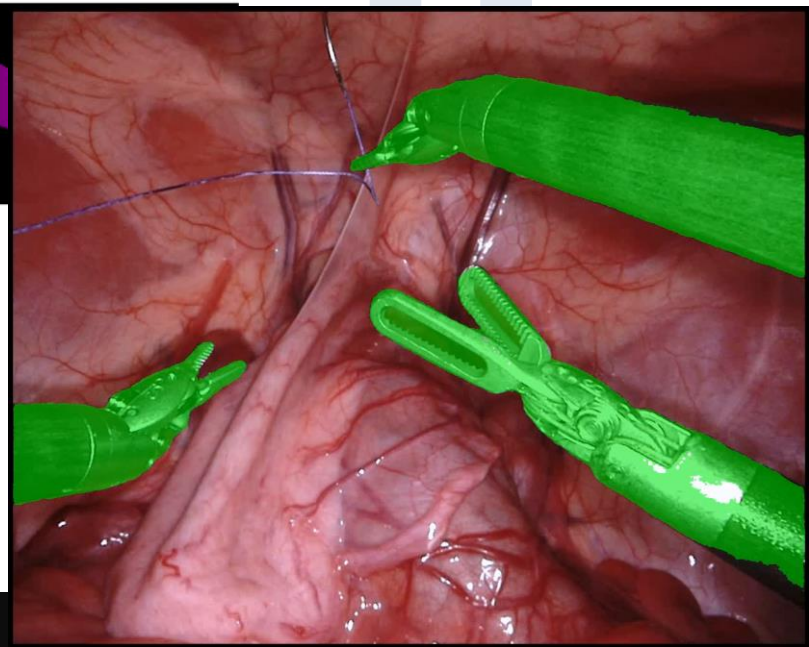






DNN based applications





Koellner Med – spine project

https://koellner-medical.com/

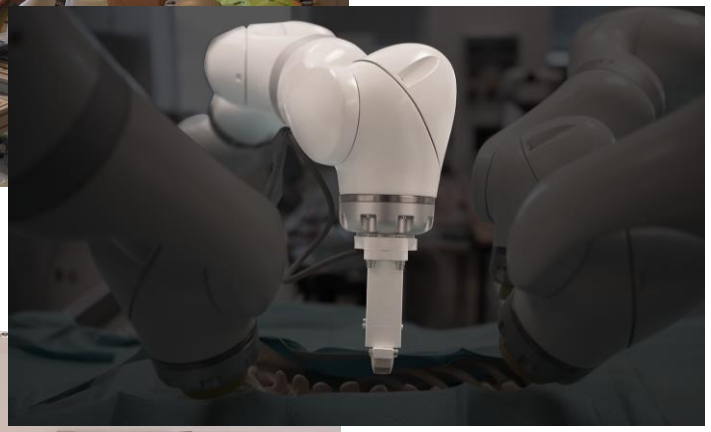
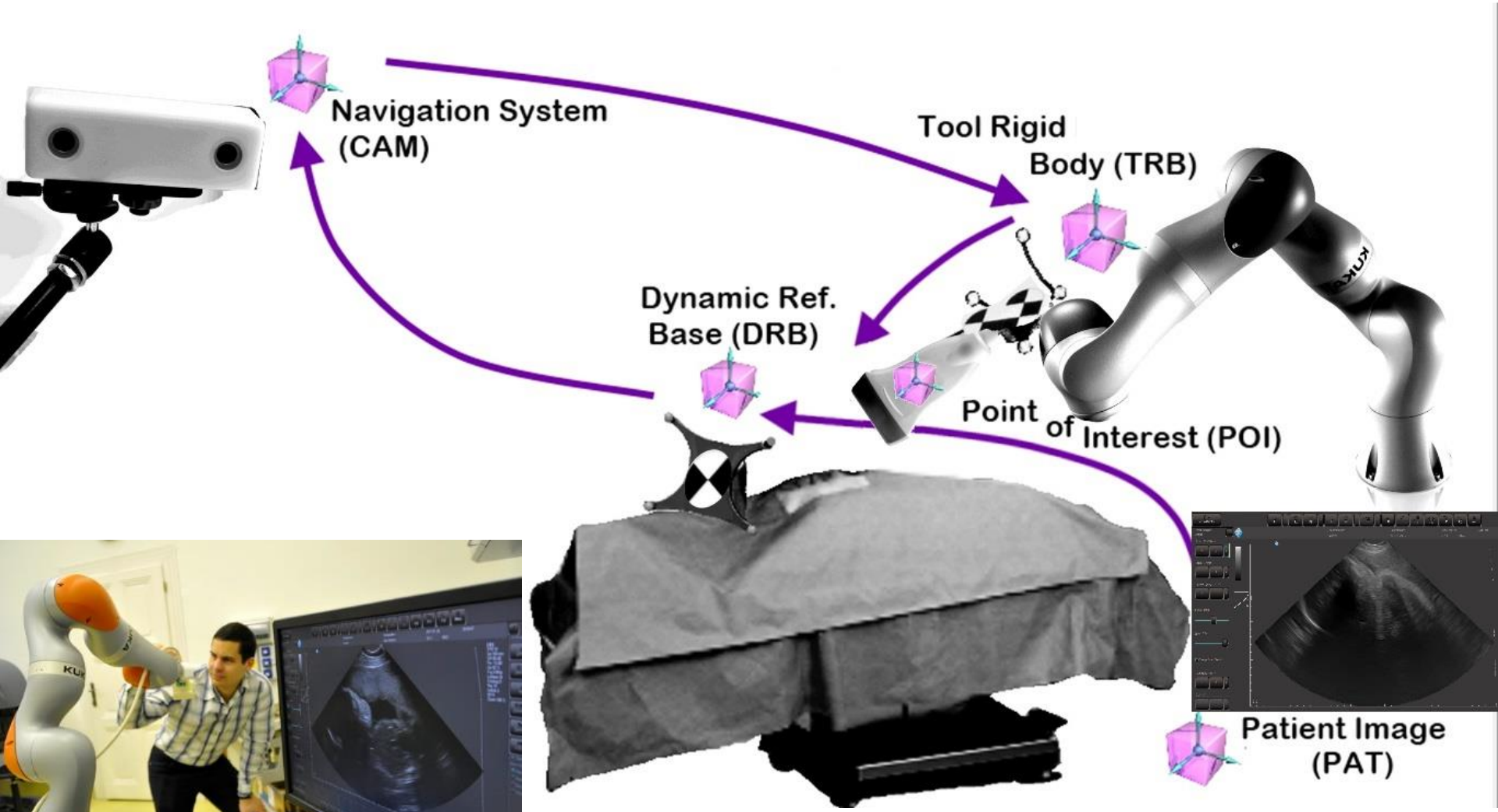
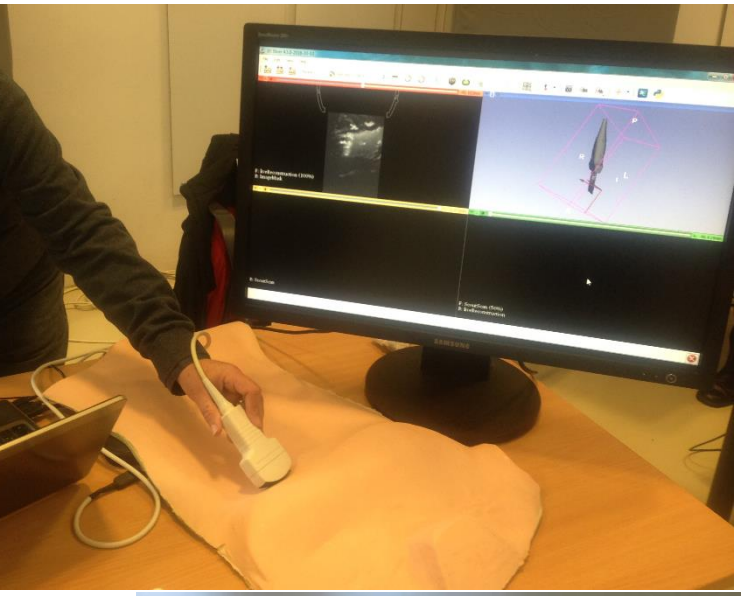


Image-guided US targeting



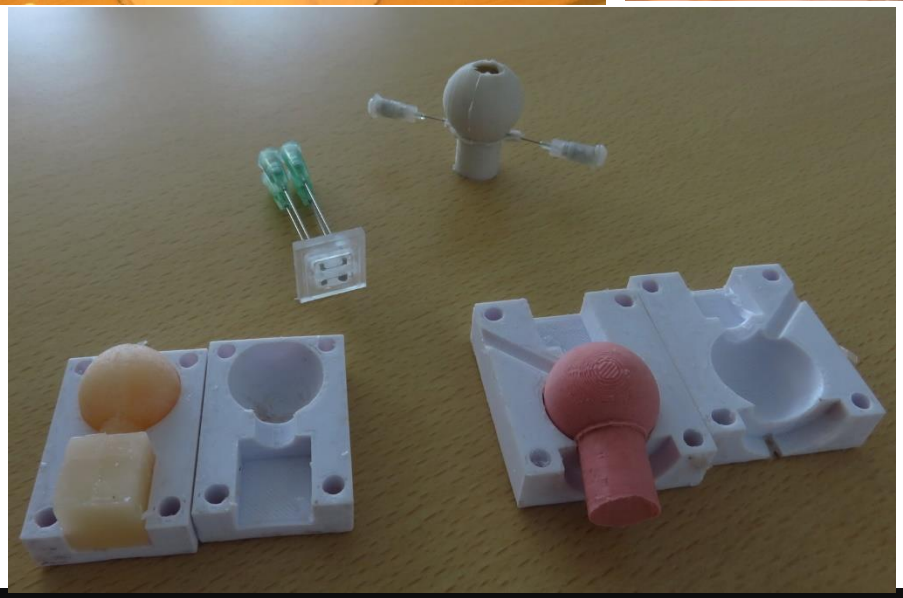
IROB approach



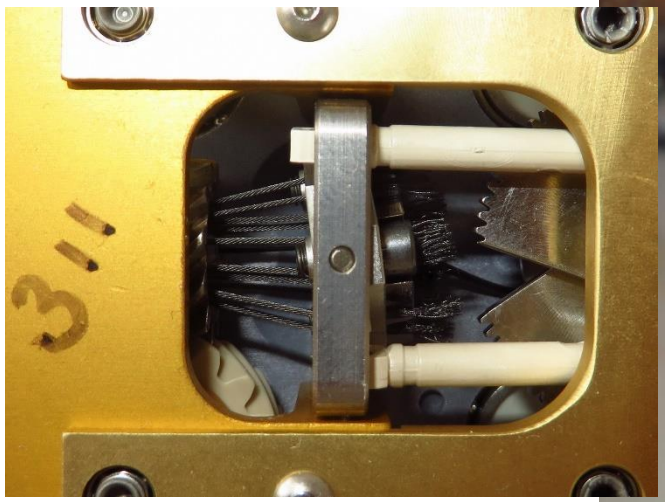
3DSlicer

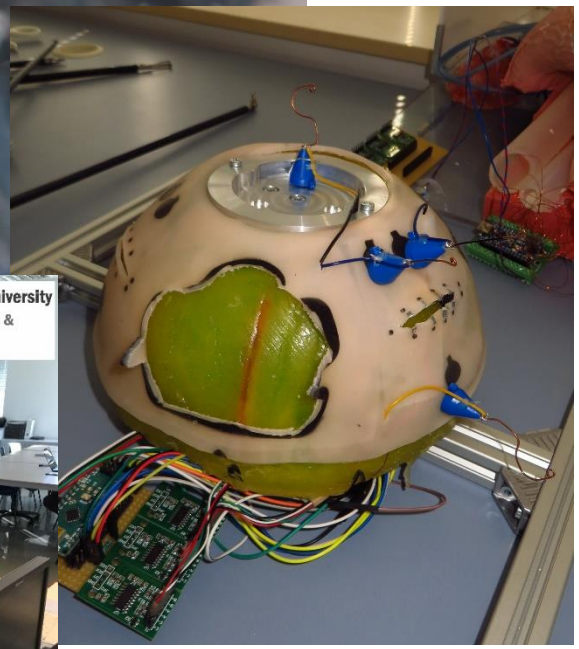
ROS

Open Source Robotics Foundation

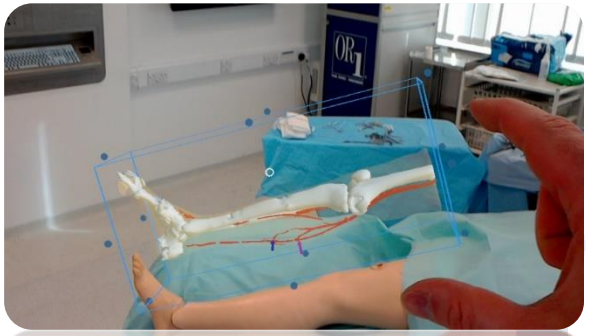


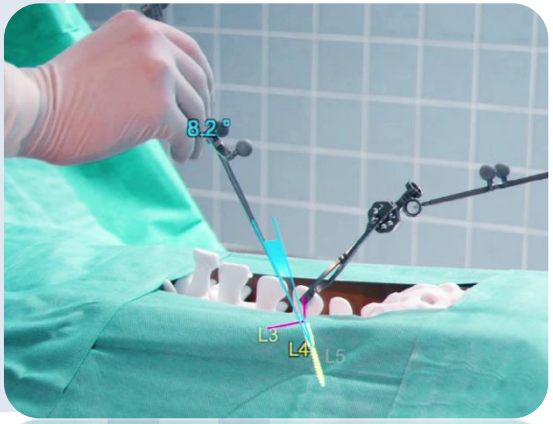
IROB approach

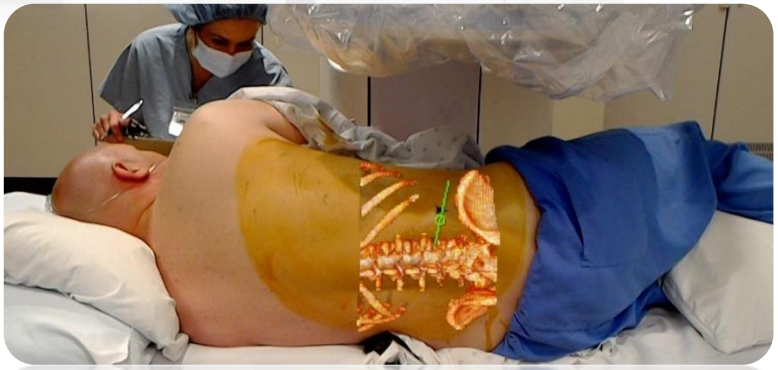




Augmented / Extended Reality (XR) for spine applications

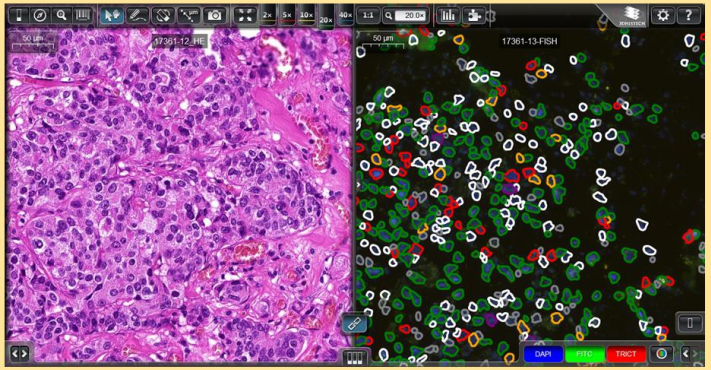






KIKOK – Cyber-Medical Center

Digital pathology and lab automation - HW



Digital pathology - SW

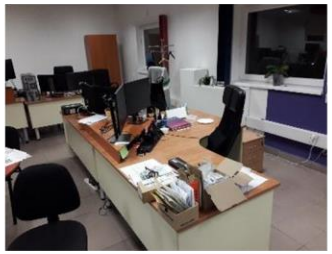
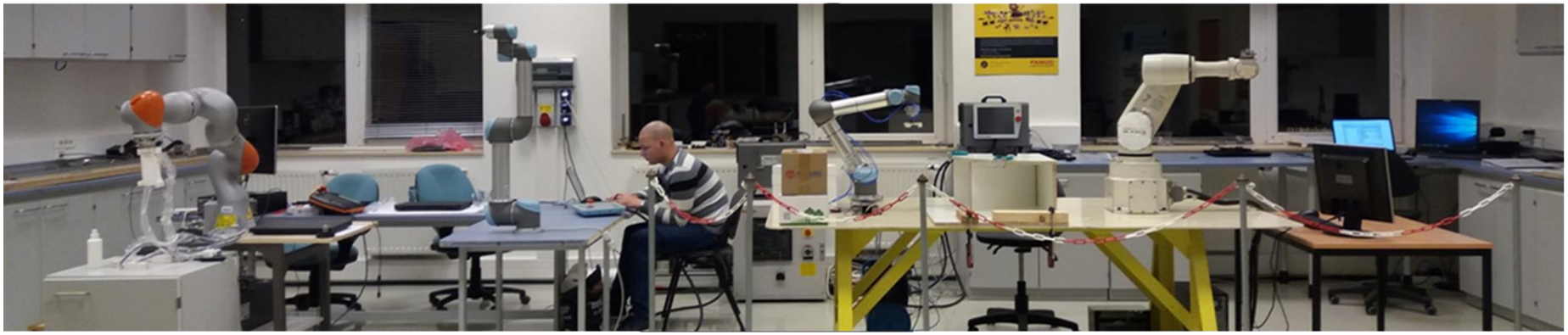
Diabetes decision support systems

Digital support for animal experiments
Cancer therapy optimization

KIKOK infrastructure





https://kikok.uni-obuda.hu/

17 UN Sustainable Development Goals (SDGs)

Sustainable robotics

http://www.sustainablerobotics.org

Involvement in standardization

International Organization for Standardization (ISO) / IEC
ISO/TC 299/JWG 35, 36

- Joint Work Group on Standard for Medical Robot Safety
- Delegate of the Hungarian Standards Institution (MSZT)
- IEC TR 60601-4-1
- IEC 80601-1-77, -78

IEEE RAS standing committee for standardization

- P1872: Standard for Ontologies for Robotics and Automation
- P2730: Standard for Classification, Terminologies, and Definitions of Medical Robots
- P7000 IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems

EURobotics aisbl

- Topic Group—Standardisation

Robotics is here to stay.
Better be friends…

University Research and Innovation Center

http://ekik.uni-obuda.hu

Thank you!

Facebook Linkedin YouTube

IROB Virtual tour 2019

https://www.youtube.com/watch?v=ntsgh7cLoYM