Robotic Applications in BioMedicine:
From Molecular Imaging to Heart Surgery

Medical Robotics Laboratory, PGH 315

Department of Computer Science

http://mrl.cs.uh.edu/Home.html

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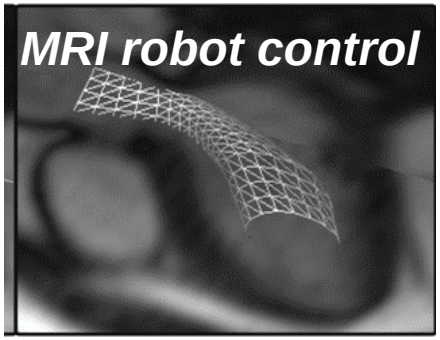
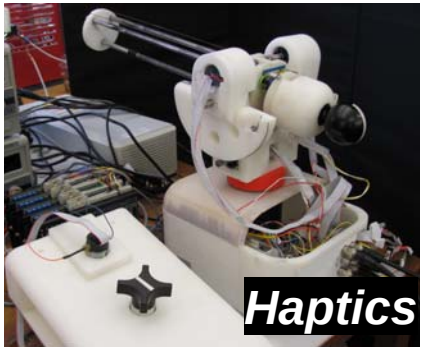
BSc (BME): **Habib Zaid**

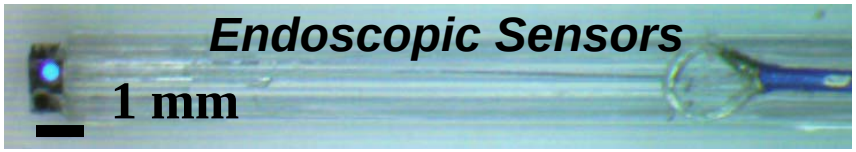
What do we do?

Develop computational methods and hardware, and integrate them for performing image-guided and robot-assisted interventions and surgeries …

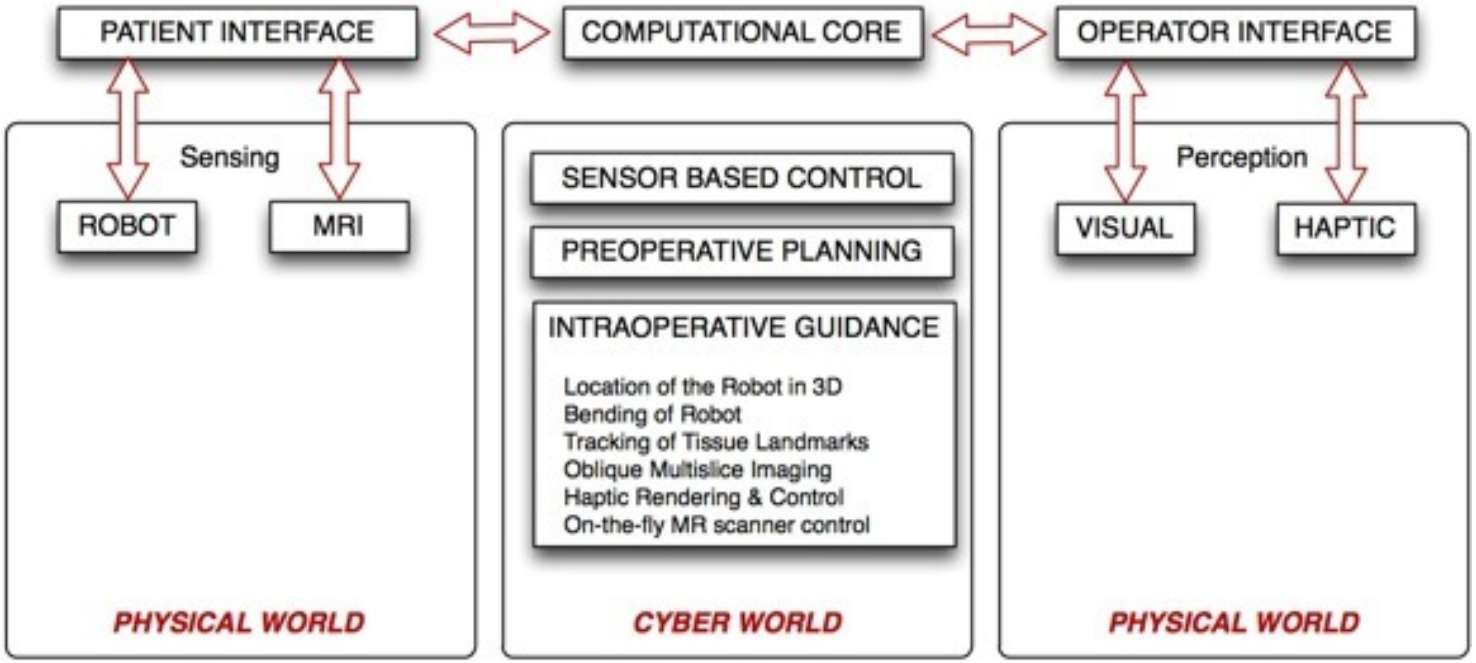
From Concepts to Actual Working Prototypes!







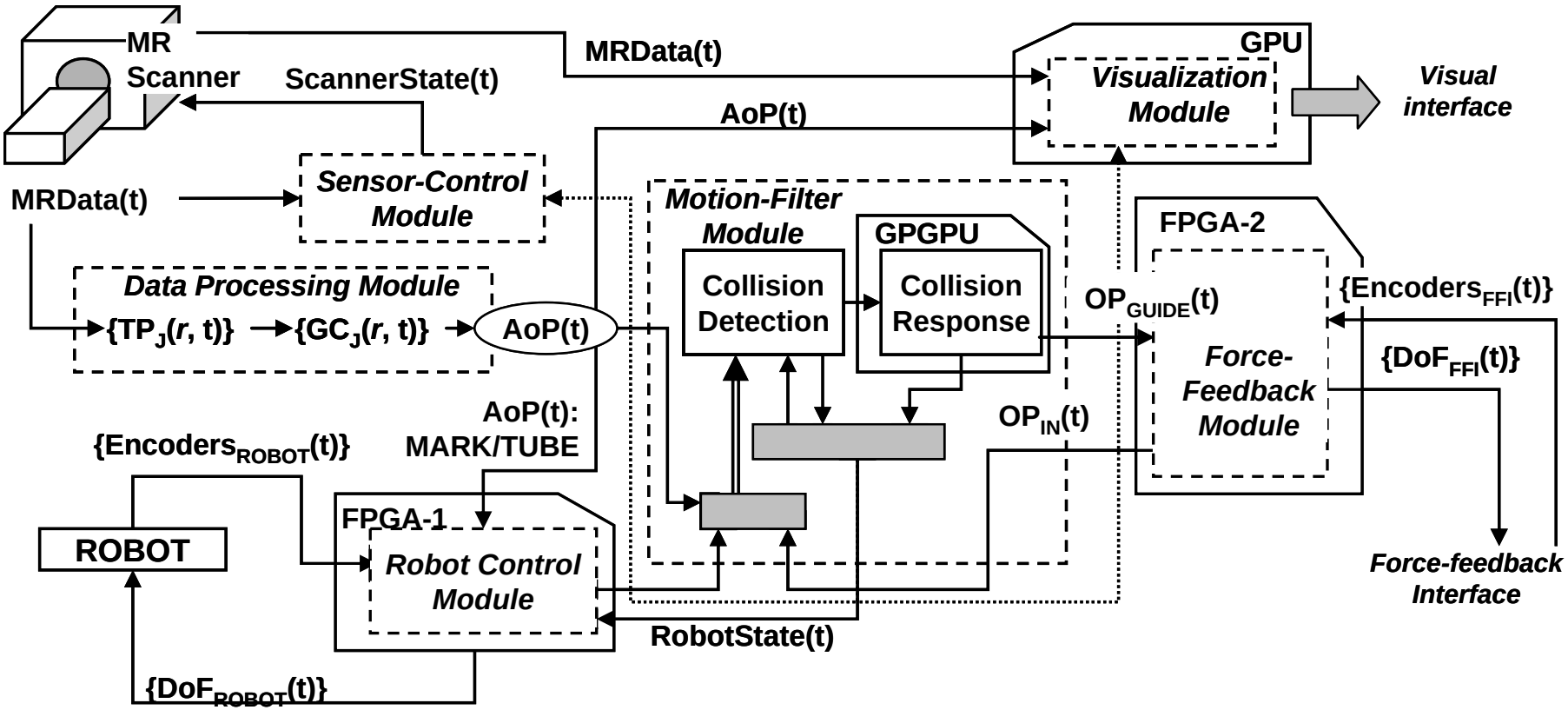
MIROS: A Cyber-Physical System Built from the Ground Up in Our Department!



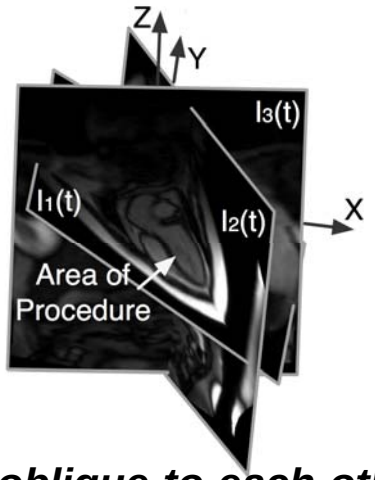
We bridge and link the physical and the cyber world

MIROS

Multimodal Image-guided RObot-assisted Surgeries

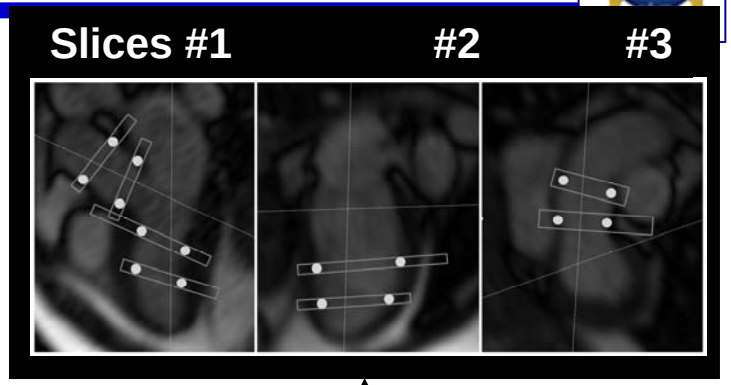


Computational Thread: Processing
Dr. N. Navkar

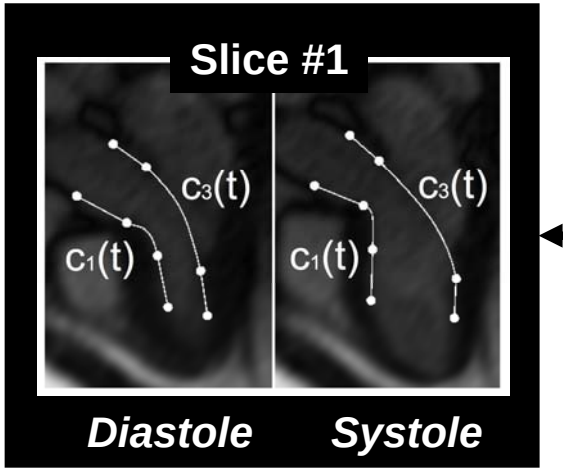


Three oblique-to-each-other slices: 49 ms/slice (20 Hz)

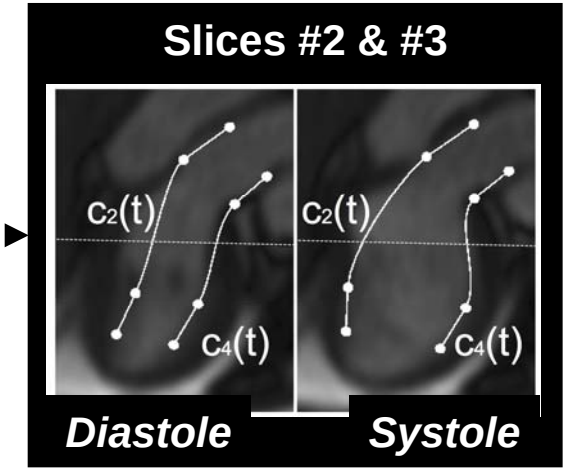
Real-time MRI feed



Projection Bands



Control Curves



Force Feedback Interface

Dynamic Virtual Fixtures

Visual Interface

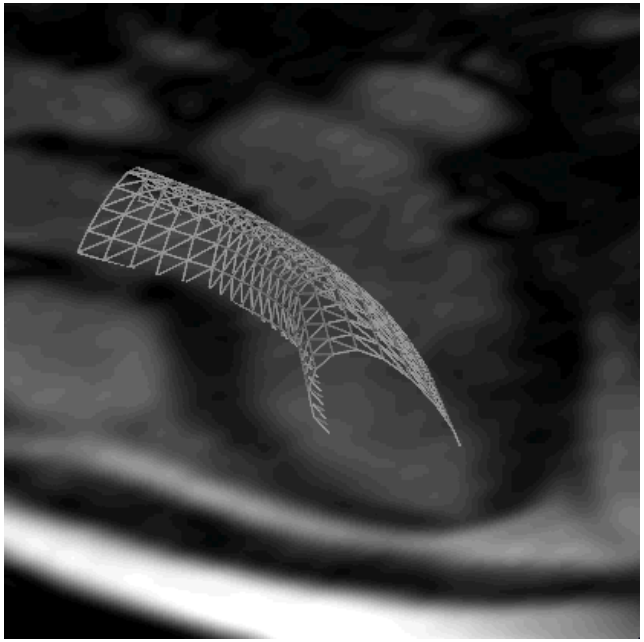
Cardiac Surgeries (Fast-fast-fast!!!)

Virtual Fixtures Generated *On-the-Fly* from the Continuous Feed of the Real-time MRI

Guidance Virtual Fixtures

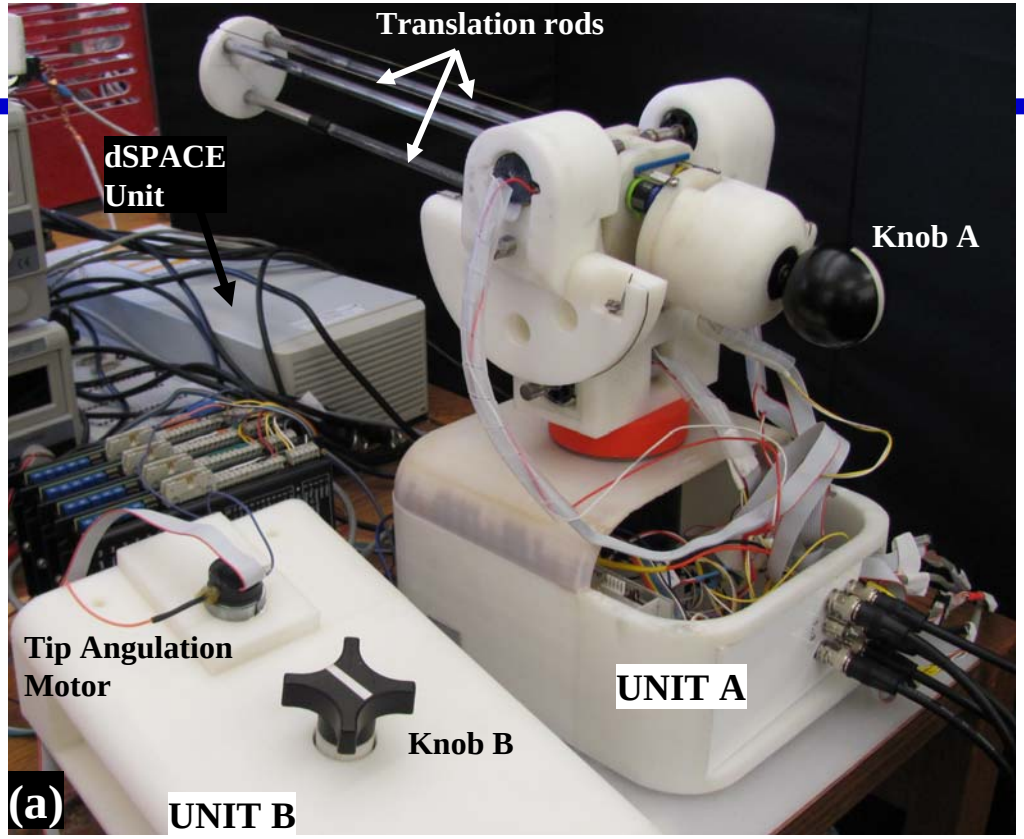
Maneuver on the curve

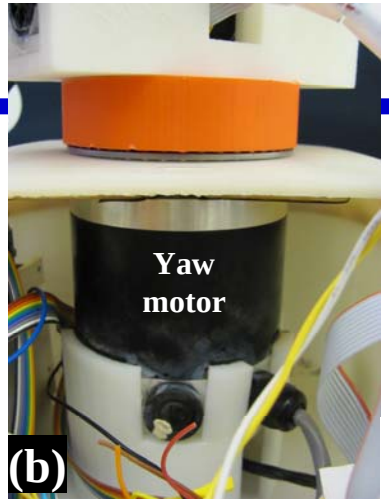
Forbidden Region Virtual Fixtures

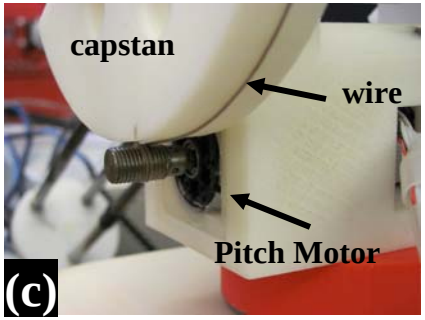


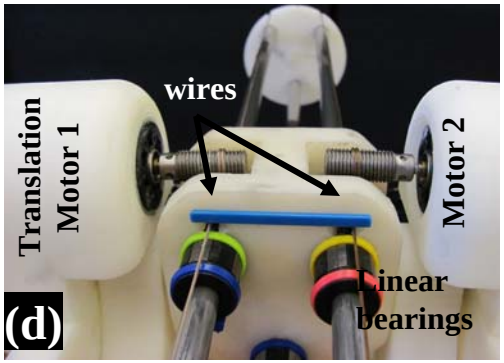
Maneuver inside the corridor

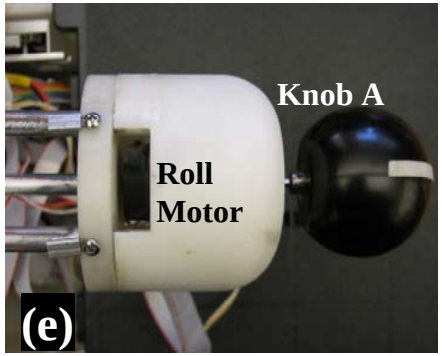
NO NEED for Models, Assumptions and unnecessary computational layers!

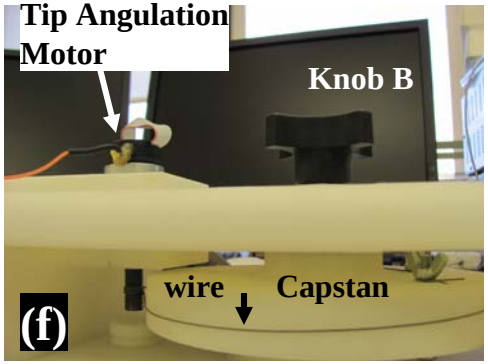

Translation rods
dSPACE Unit
Knob A
Tip Angulation Motor
Knob B
UNIT A
UNIT B
(a)


Yaw motor
(b)


capstan
wire
Pitch Motor
(c)

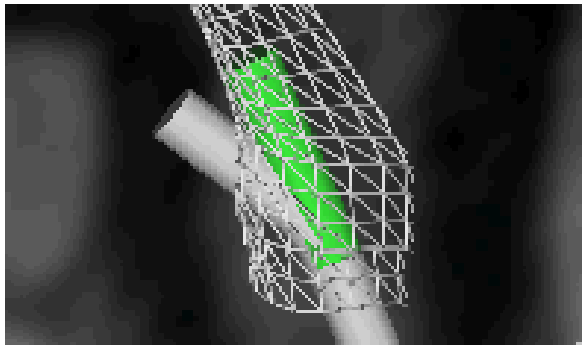

wires
Translation Motor 1
Motor 2
Linear bearings
(d)


Knob A
Roll Motor
(e)

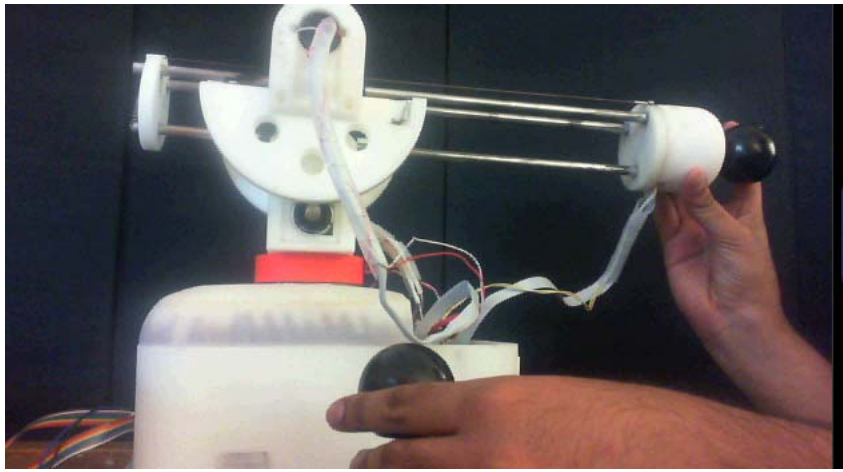

Tip Angulation Motor
Knob B
wire
Capstan
(f)

Enhanced Reality and Haptics

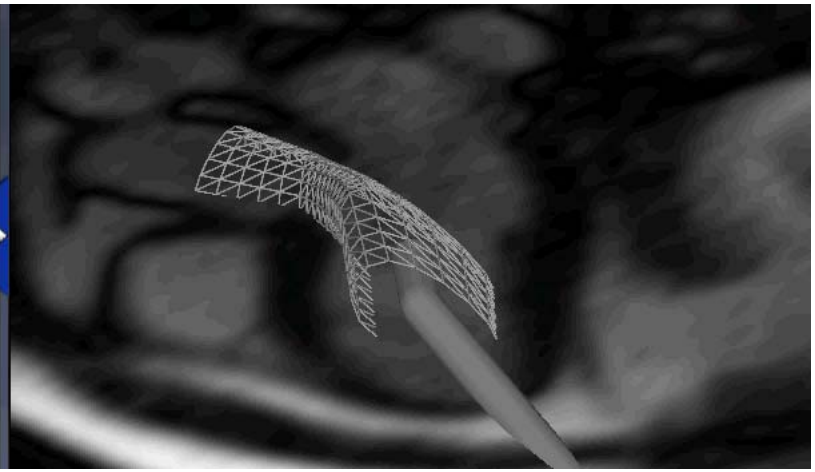
Dr. N. Navkar & Dr. E. Yeniaras



- The forces exerted on the operator direct the actual robot (gray) to match its proxy (green)
- The proxy is calculated to stay always inside the forbidden region corridor



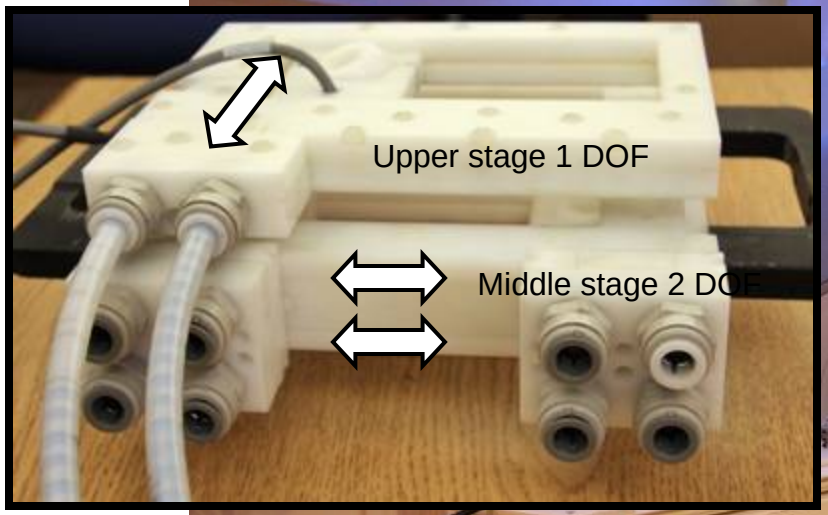
Force-Feedback Interface
(In-house developed 5 DoF)

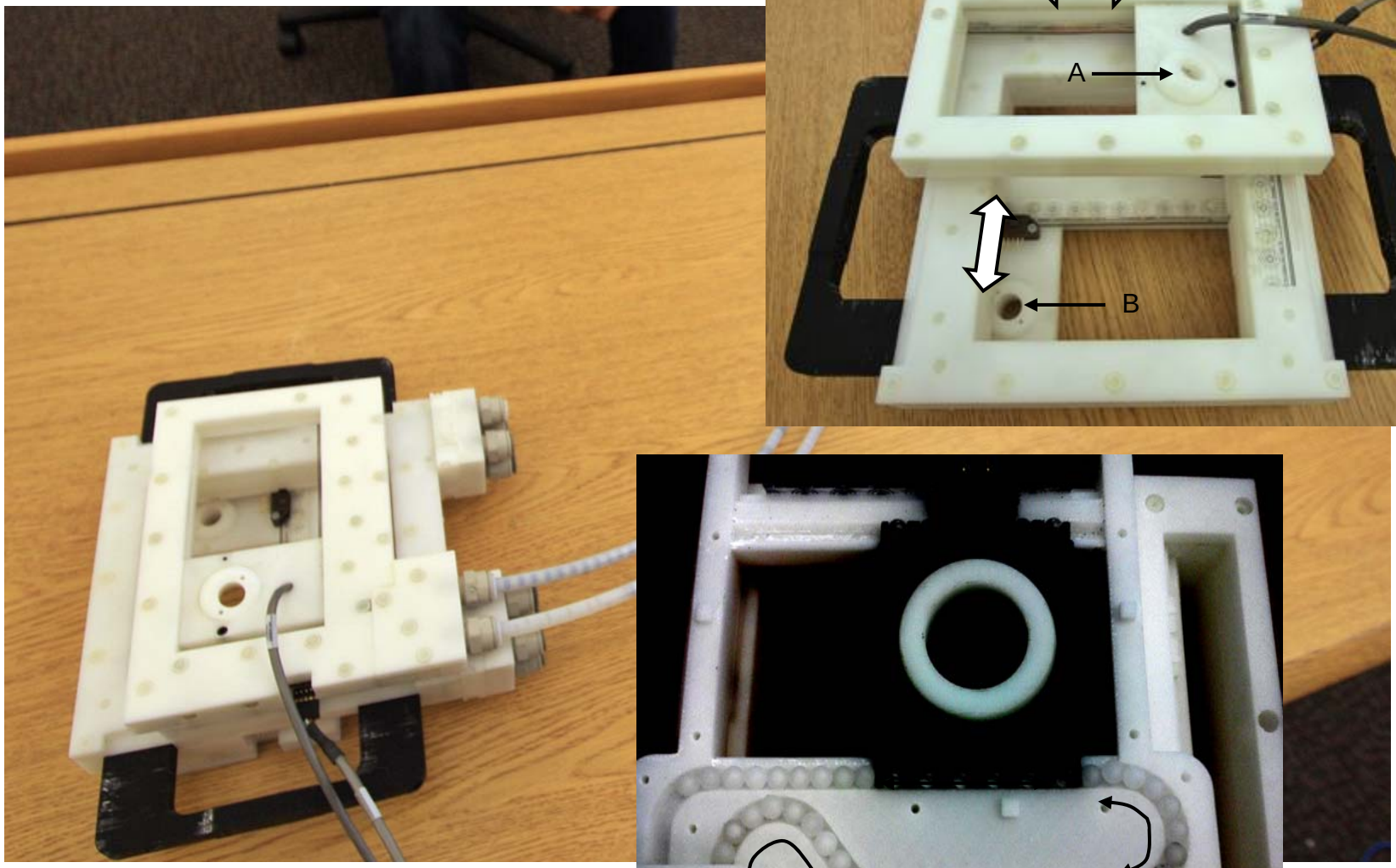


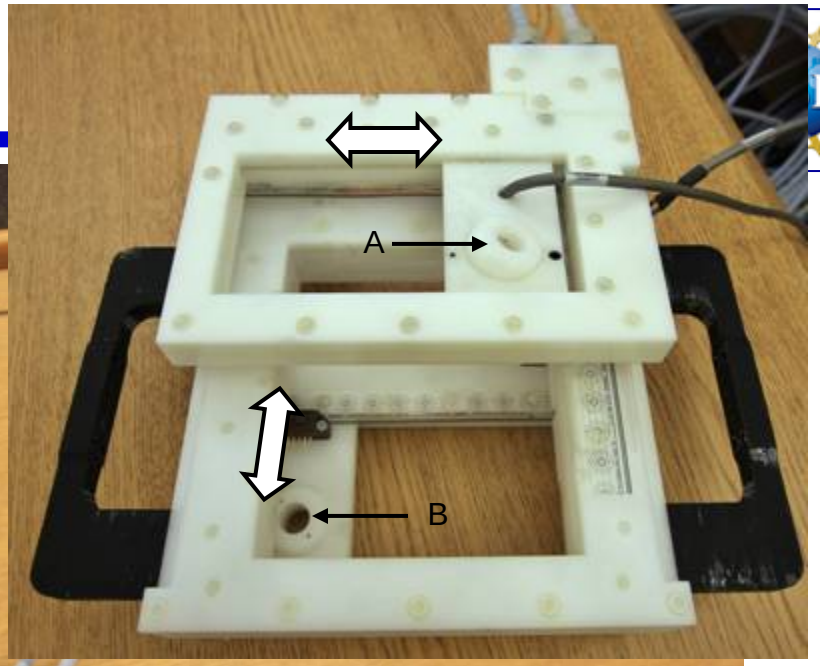
Visualization Interface
(High Definition LCD)

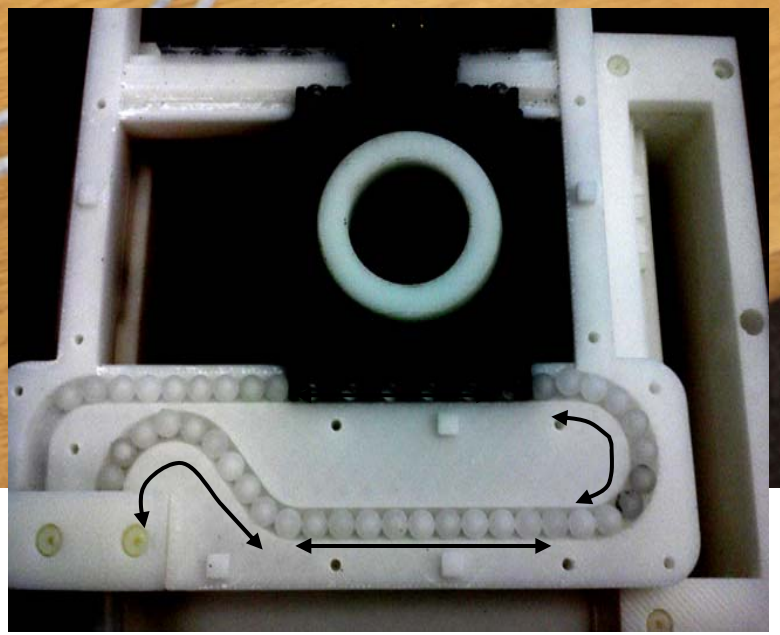
In-house Developed MR-compatible Robot

N. Sternberg (PhD); H. Zaid, BSBME; J. An (PhD)



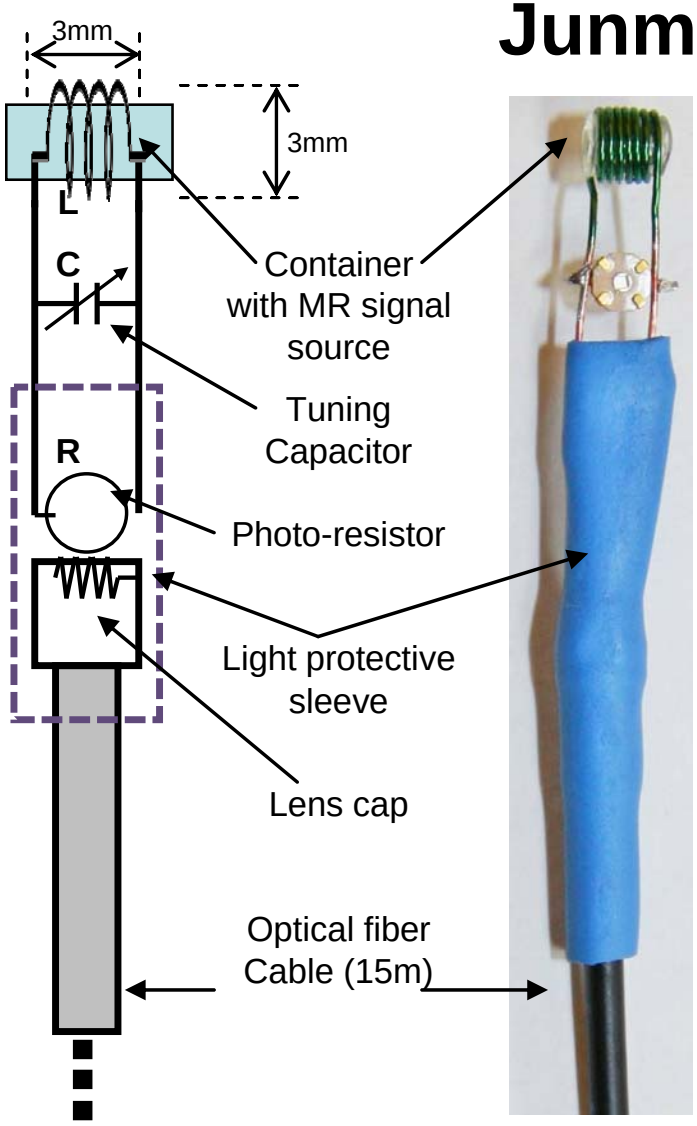



A
B

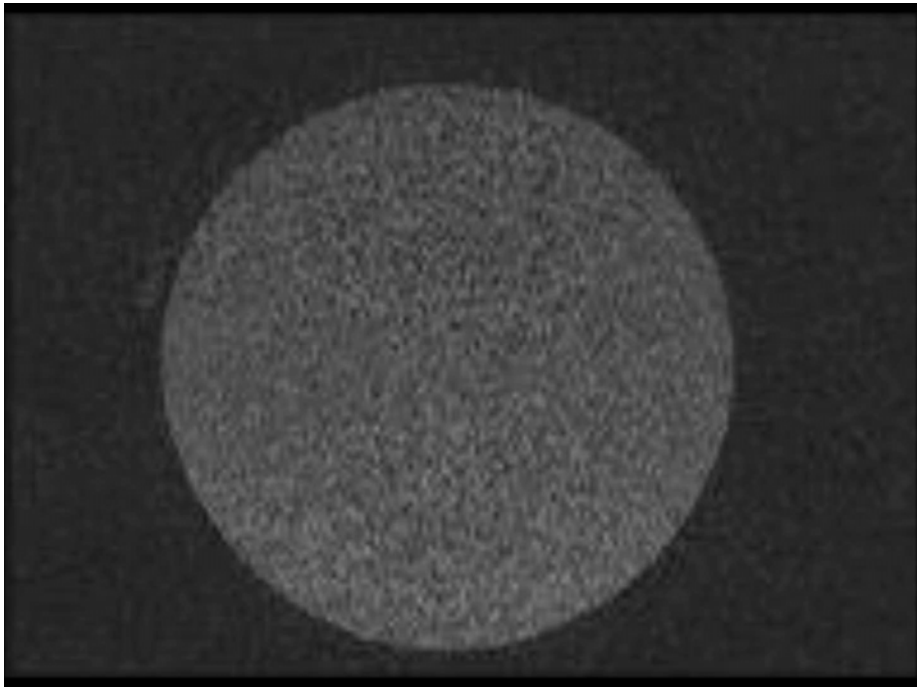


Tracking A Robot With MRI

Junmo An (PhD)

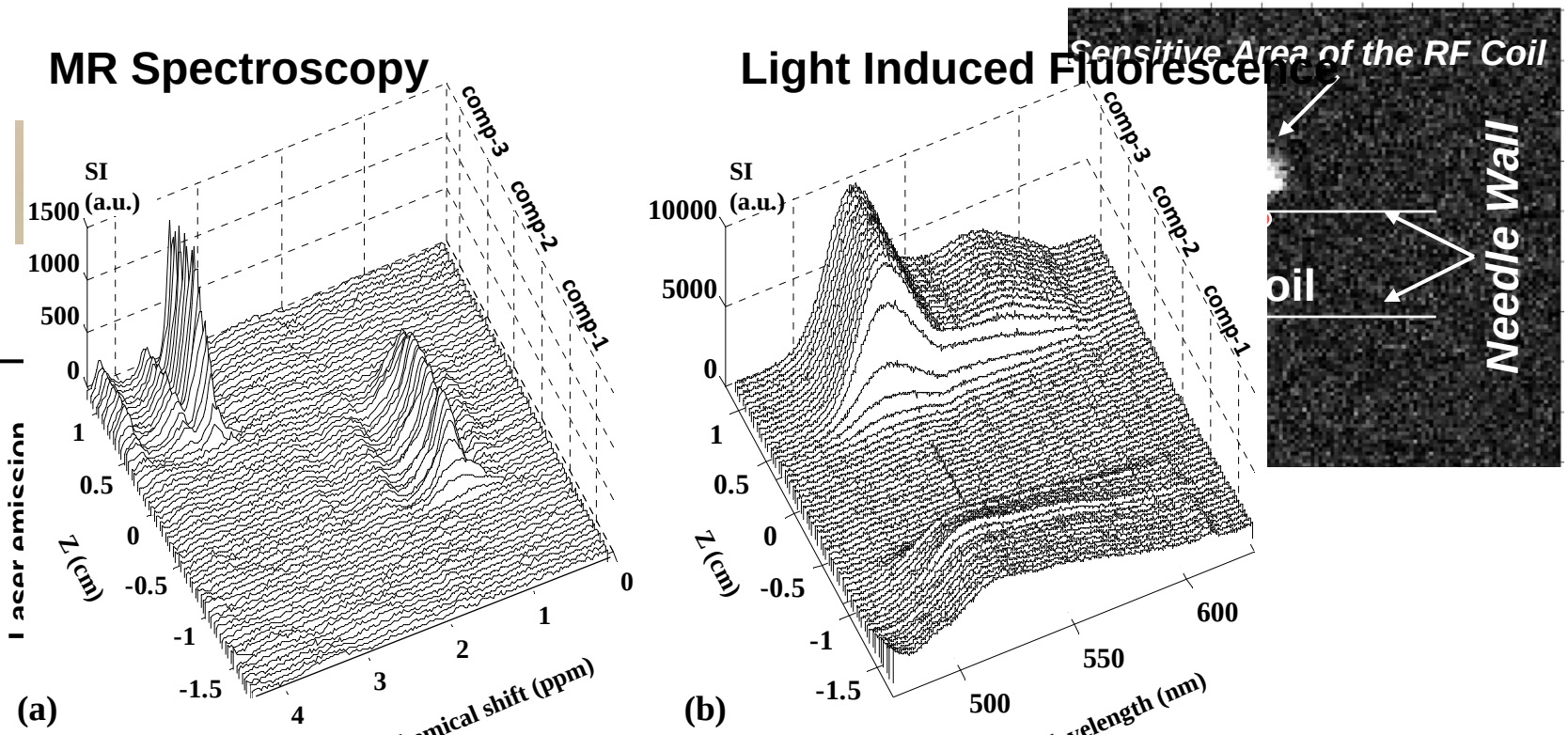


Robot Controls which markers are MR visible!
-Faster
- Less Computing!



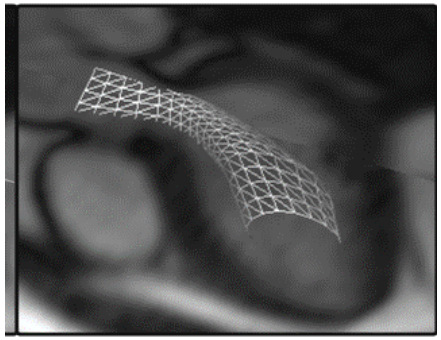
The MRI+Optical Needle Probe

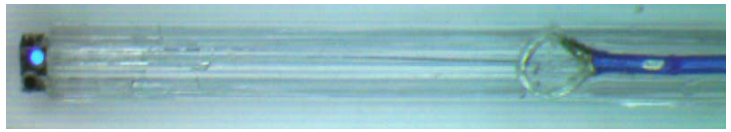
Dr. Ahmet Sonmez

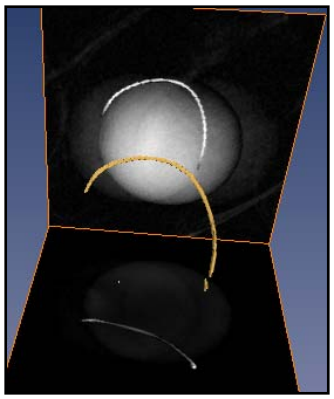


The first ever endoscopic work on concurrent MRI and optical sensing!

Thank you!







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