

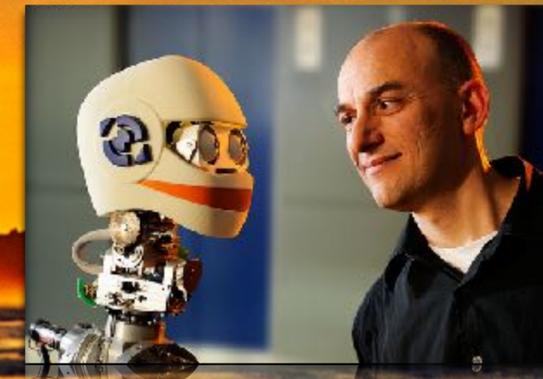
# Robot mijn zorgmaatje

**LEO** ● CENTER  
FOR  
SERVICE ROBOTICS

Groet en ontmoet

**INSPIRERENDE  
INGENIEURS**

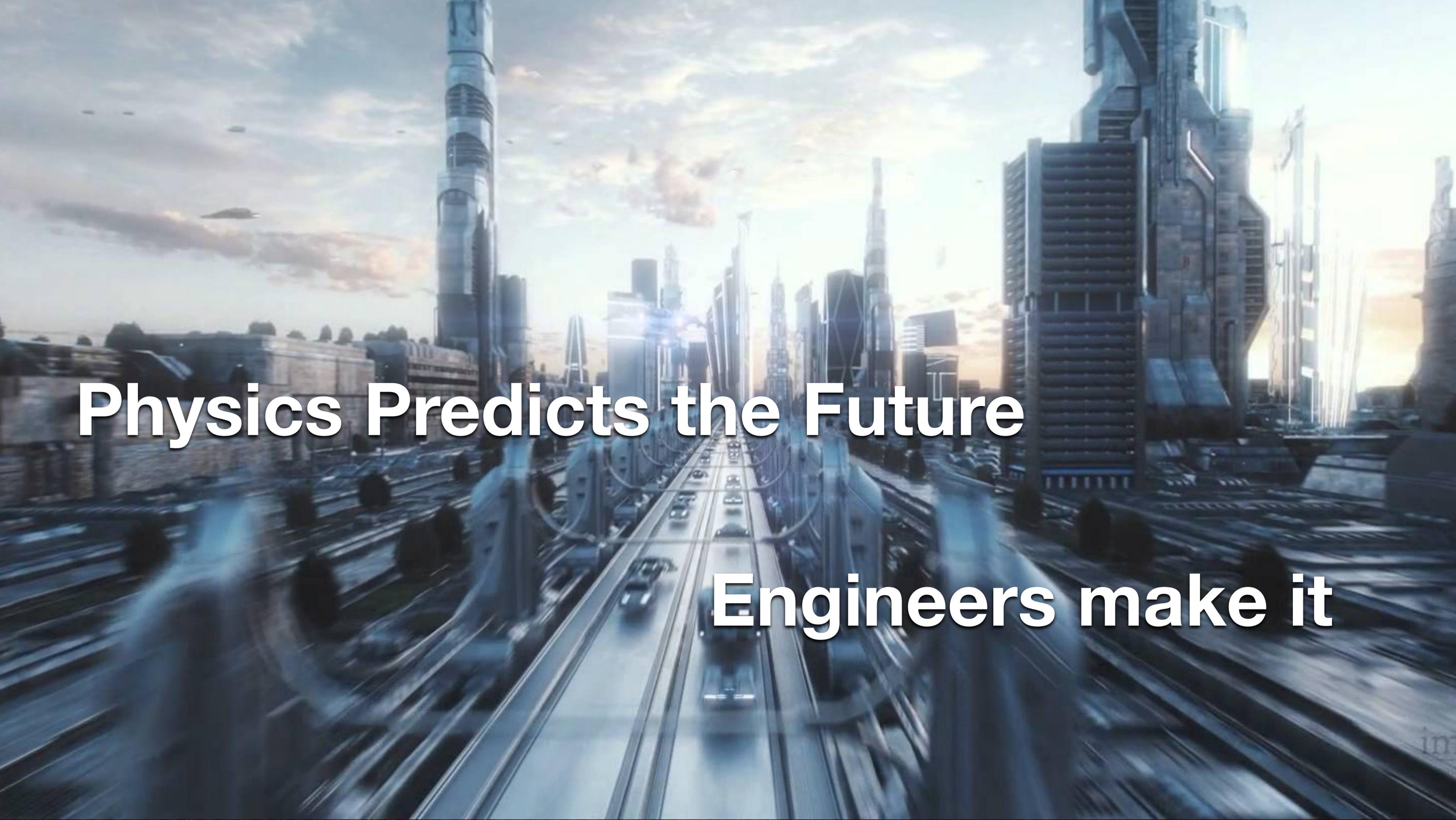
ZONDAG 2 OKTOBER, DEN HAAG, 10-16 UUR  
Informatie en aanmelden [www.kivi.nl/inspirerende-ingenieurs](http://www.kivi.nl/inspirerende-ingenieurs)



**Prof.dr.ir. Stefano Stramigioli**  
IEEE Fellow  
VP Research euRobotics/SPARC  
Chair RAM  
(co)-funder LEO, RoboNED

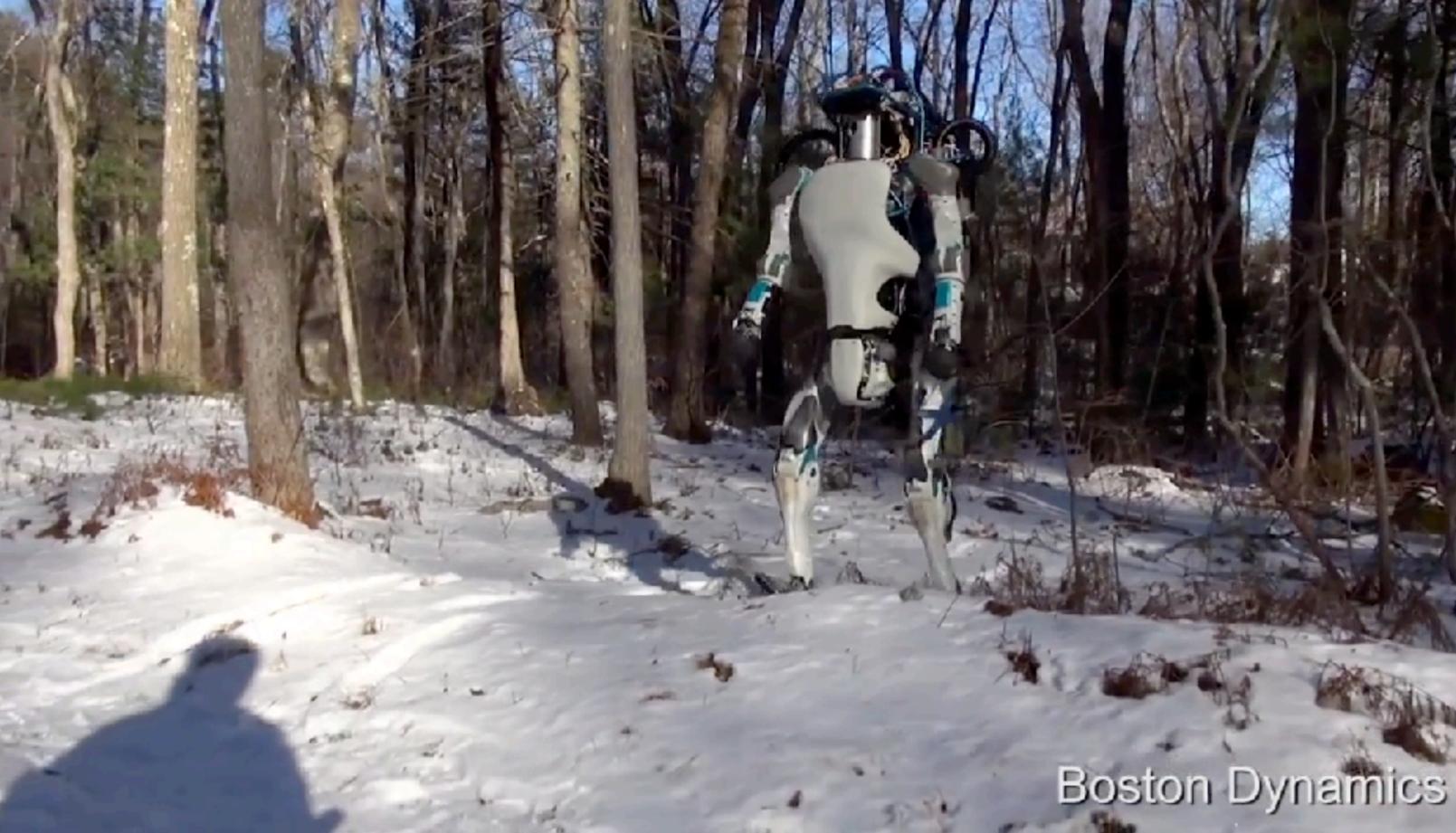
**RAM** ● ROBOTICS  
AND  
MECHATRONICS

UNIVERSITY OF TWENTE.

A futuristic cityscape with tall, sleek buildings and a central elevated roadway with cars, set against a sunset sky. The scene is rendered in a cinematic style with a blue and orange color palette. The text "Physics Predicts the Future" is overlaid in white, bold, sans-serif font across the middle of the image.

**Physics Predicts the Future**

**Engineers make it**



Boston Dynamics



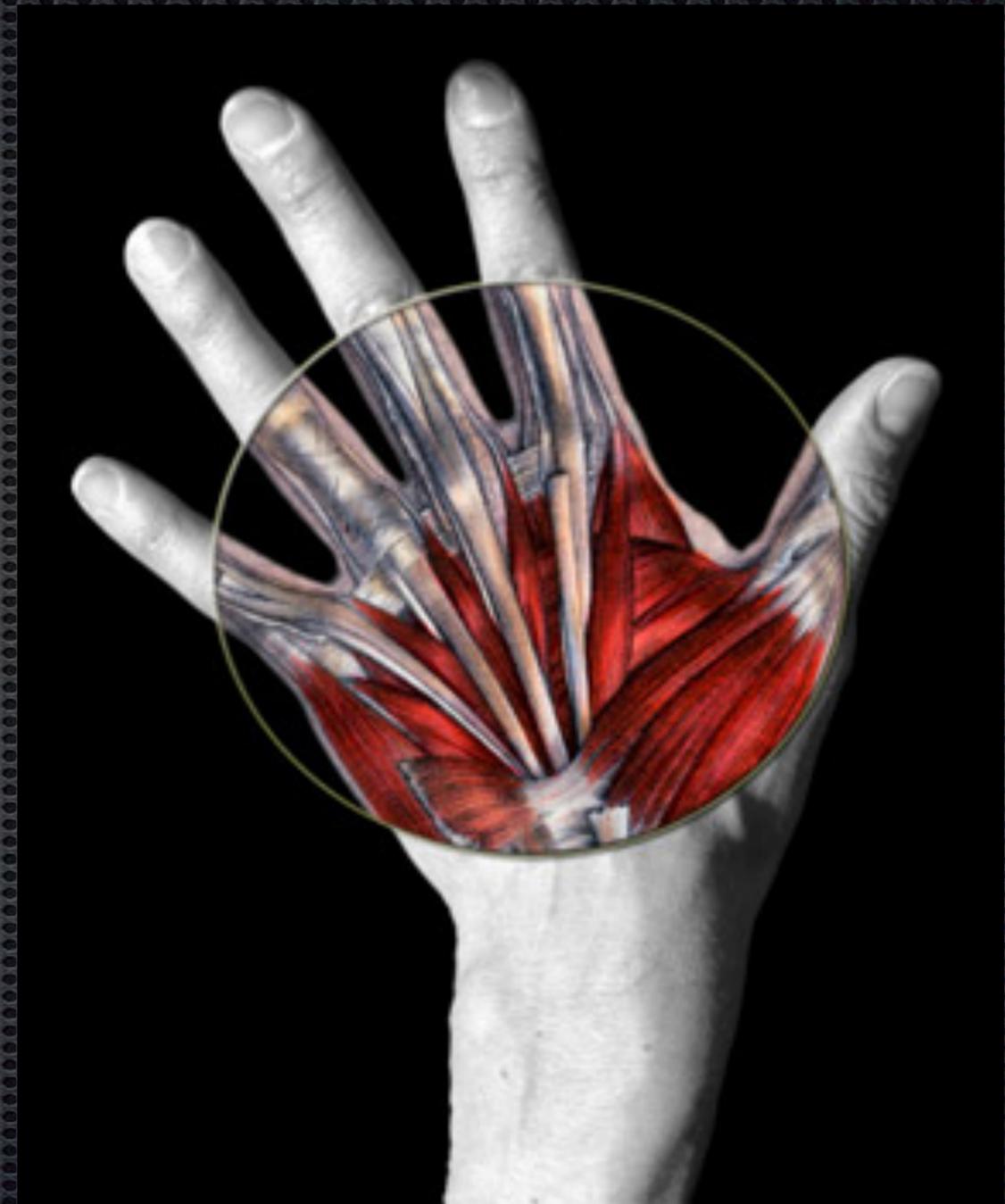
Boston Dynamics



# The big challenges



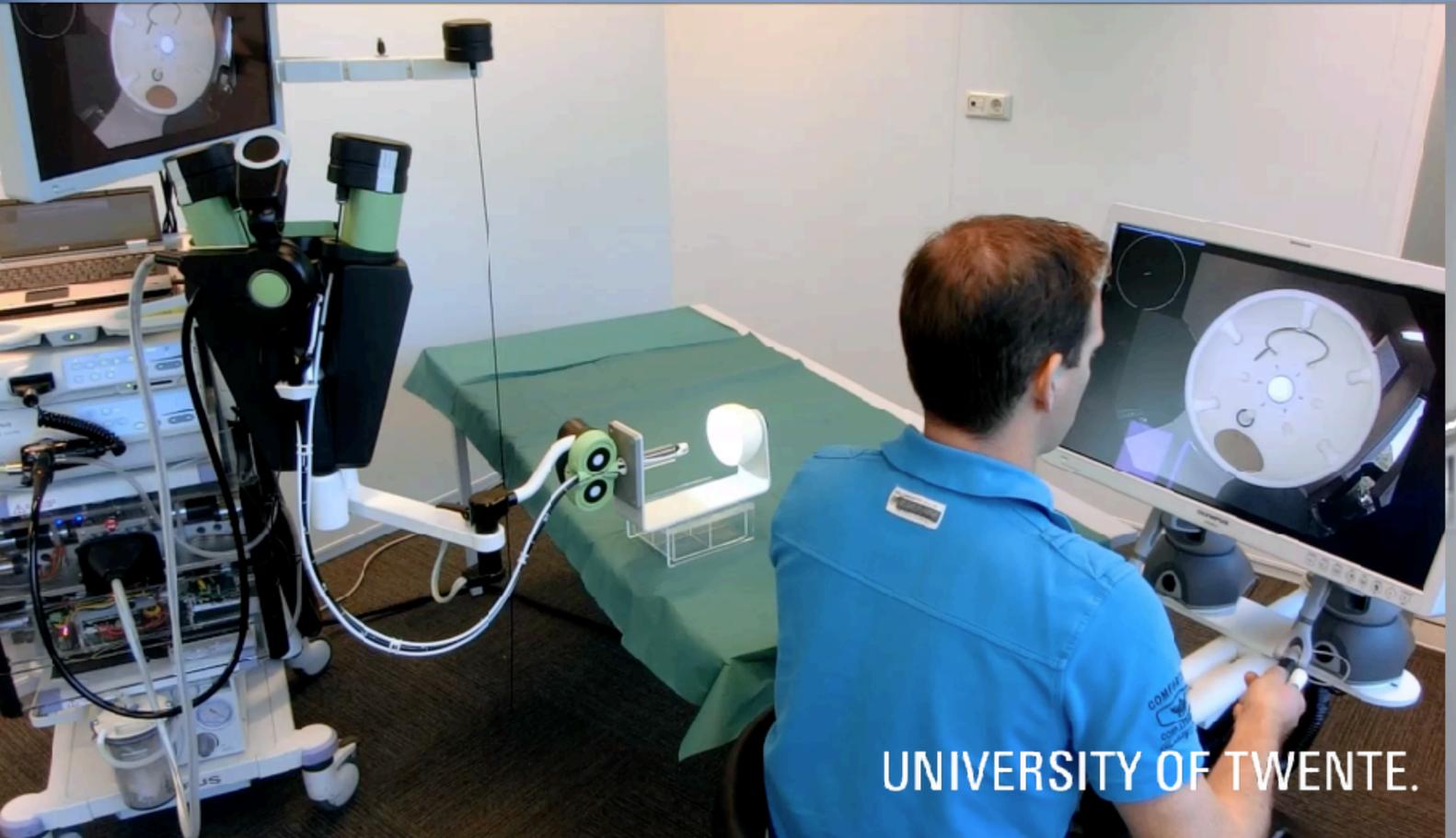
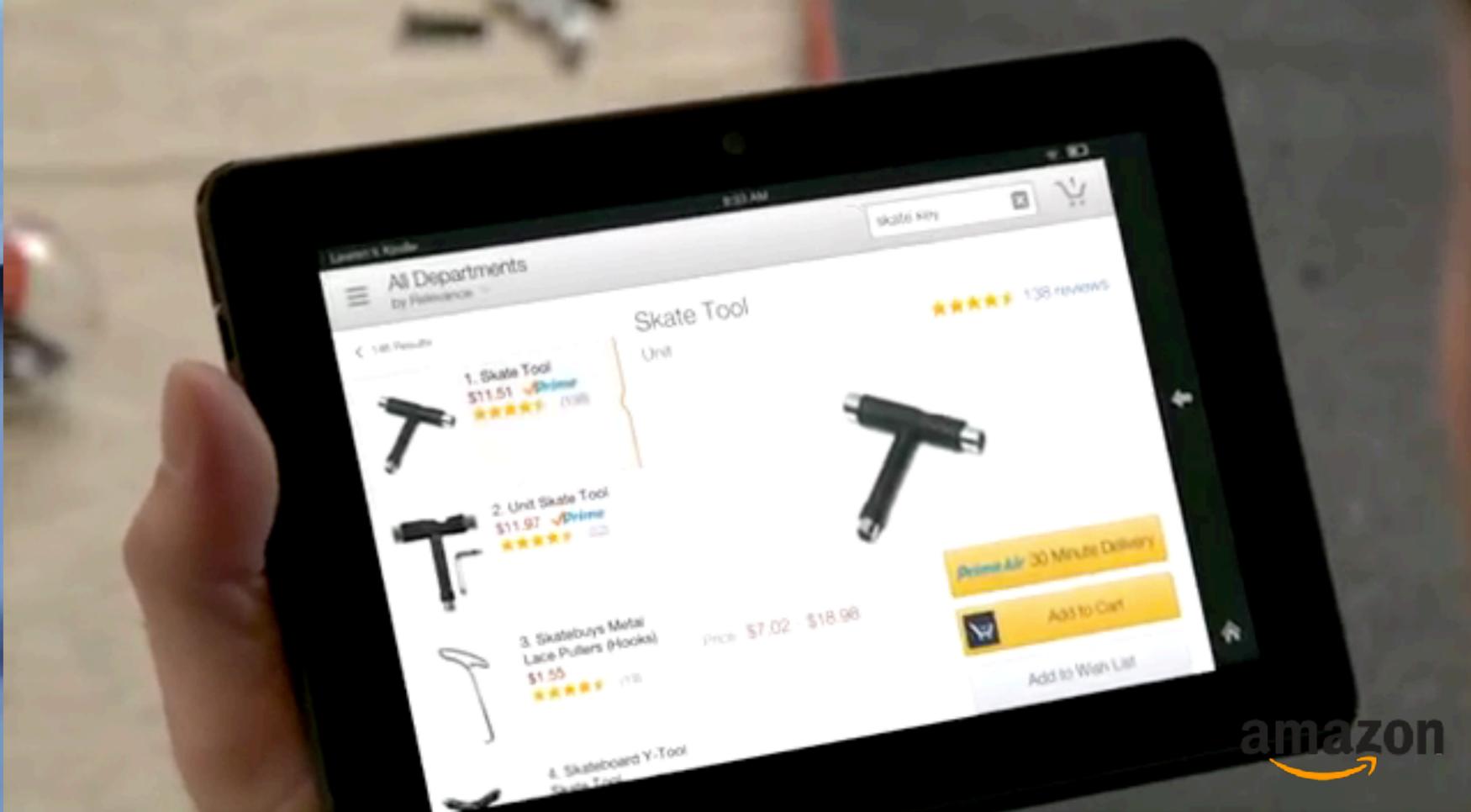
Cognition



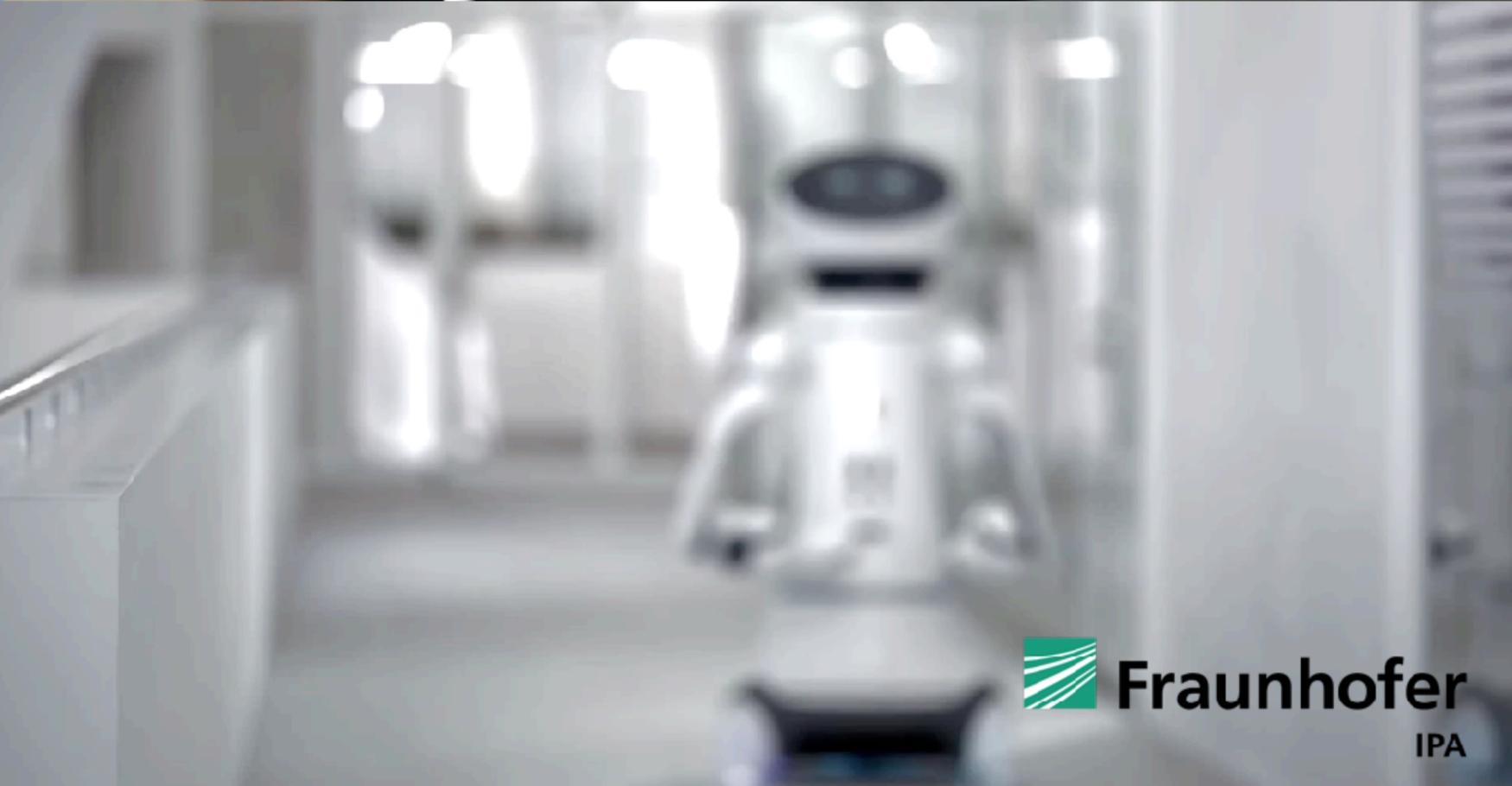
“Hand”



UNIVERSITY OF TWENTE.



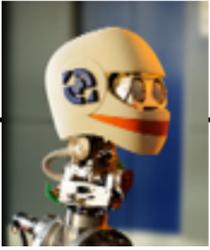
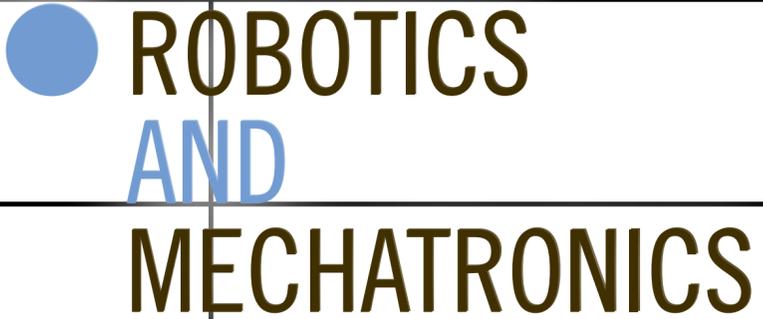
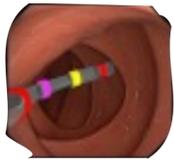
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 **Fraunhofer**  
IPA

# Application Fields

Core Research

	Medical	Inspection & Service	Home & Care	
Modeling	<b>RMM</b>			
Control				
Embedded				
Imaging				
Design				

# RAM

● ROBOTICS  
AND  
MECHATRONICS

Prof. dr. Jurgen Fütterer Radiologist  
Prof.dr Ivo Broederes Surgeon



## Robotics&Mechatronics

### Personel Lab

- 3.6 Full Prof
  - 4.2 Assoc. Prof
  - 2 Assist. Prof
  - ± 5 Post Docs
  - ± 25 PhD cand.
  - ± 4 Temp Staff
  - 1 Secretary
  - 3 Technicians
- 350 m2
  - Rapid Pro Lab
  - Flying Testing

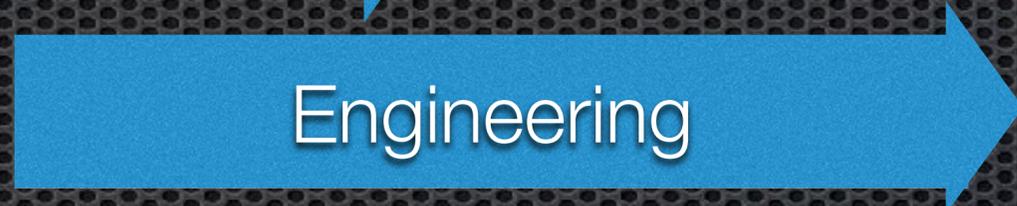
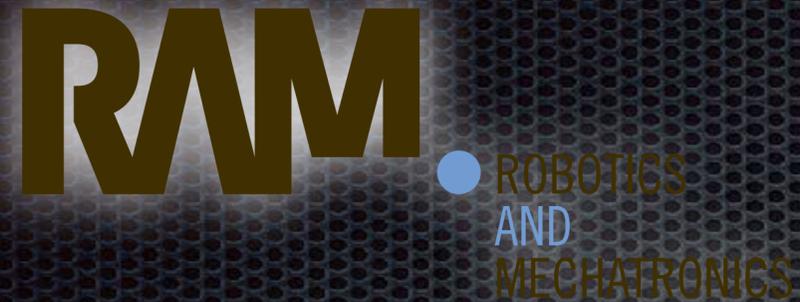
### Year Budget

- 3.7 ME

**Motto: TEAM**  
**Together Everybody Achieves More**

UNIVERSITY  
OF TWENTE.

# Toward Products



Product





300 m<sup>2</sup>



**Objet 250 Eden  
3D Printer**



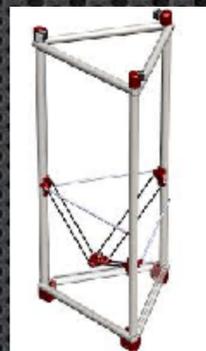
**2x Ultimaker-2  
3D printers**



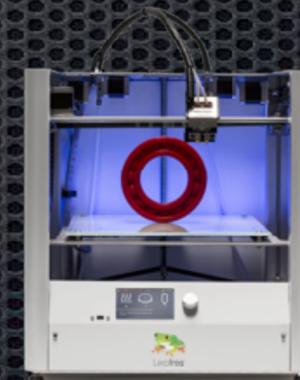
**Trotec Speedy 300  
80 Watt CO2 lasersnijder**



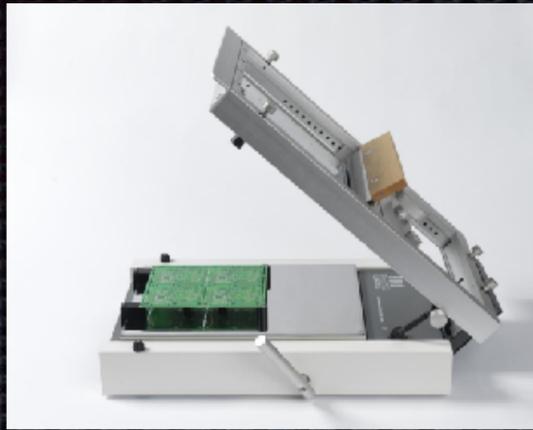
**Stratasys uPrint SE plus  
3D printer**



**Opilliones  
3D printer**



**2x Leapfrog Creatr  
HS 3D printers**



**Eurocircuits PCB manufacturing tools**



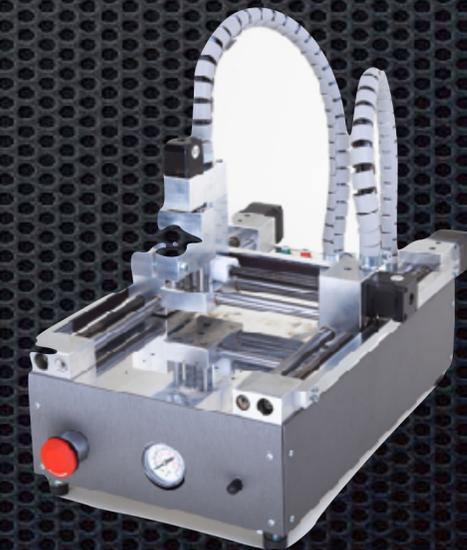
**Chemical Workstation**



**folie snijplotter GCC  
Expert 24LX**



**Transferpers  
Calortrans CT-3845**



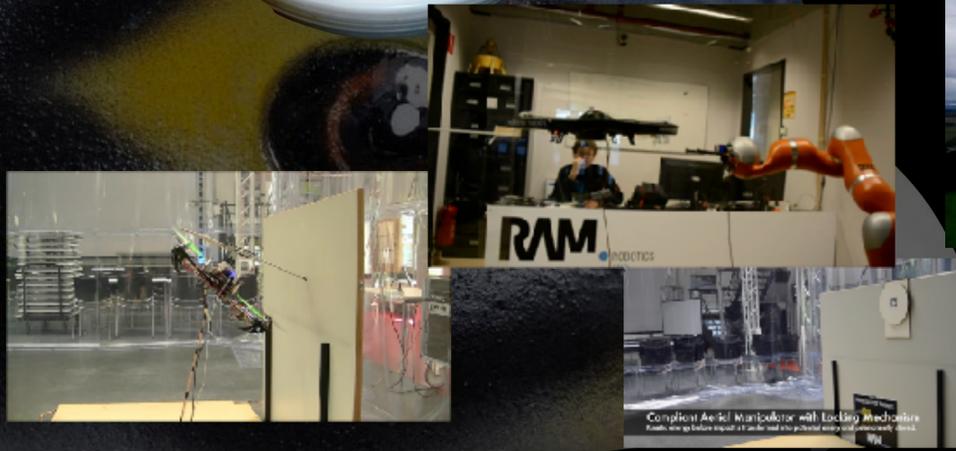
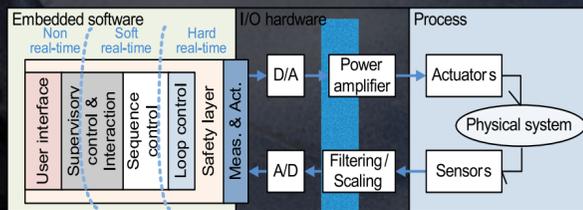
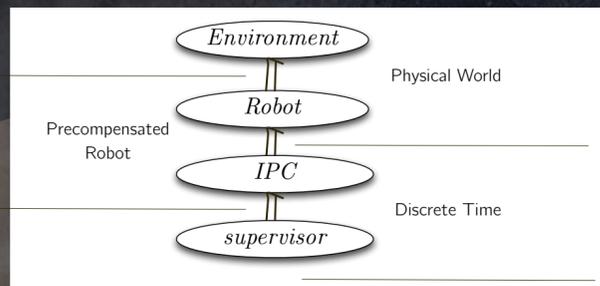
**Cirquoid PCB  
prototyping machine**

## Domain Independent

$$\dot{x} = n(t)\tilde{y}$$

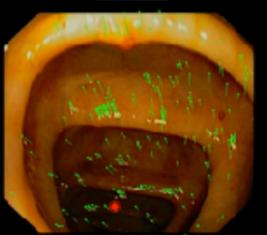
$$\tilde{u} = n(t)\frac{\partial H}{\partial x}$$

Energy Aware,  
Port Based Robotics



Theoretical

Practical



One way time delay:  
approx. 0.7s  
Distance from Enschede, Netherland to Canberra, Australia:  
10268km



Domain Dependent



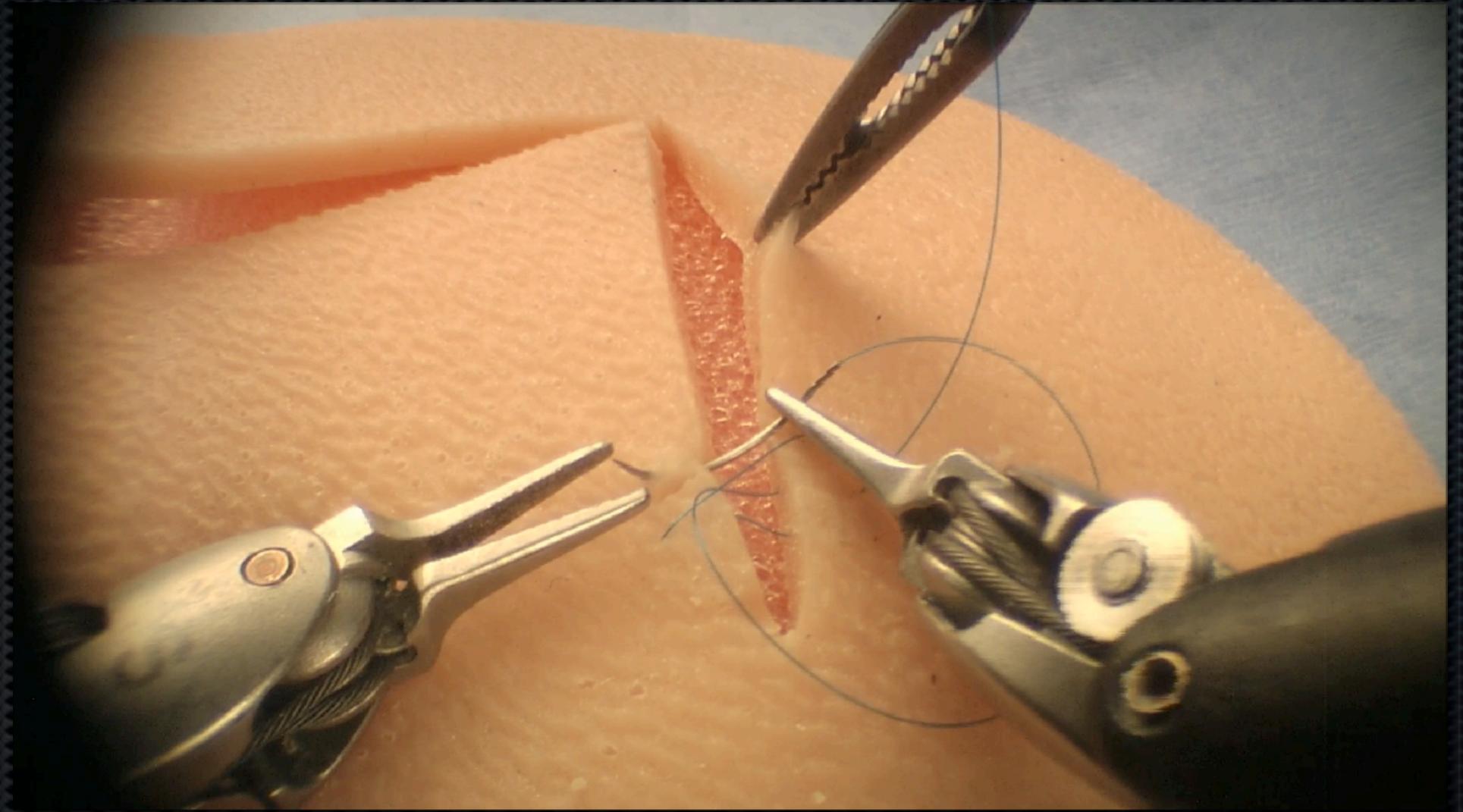


# Intuitive Surgical da Vinci

The da Vinci System

# About the da Vinci System

- Developed in the late 80s at Stanford and JHU
- Competition with the ZEUS system and legal action
- 1100 systems used worldwide, 10 in NL
- 200 systems per year sold and rising
- Monopolist for Robotics MIS
- Cost 1.5 M\$



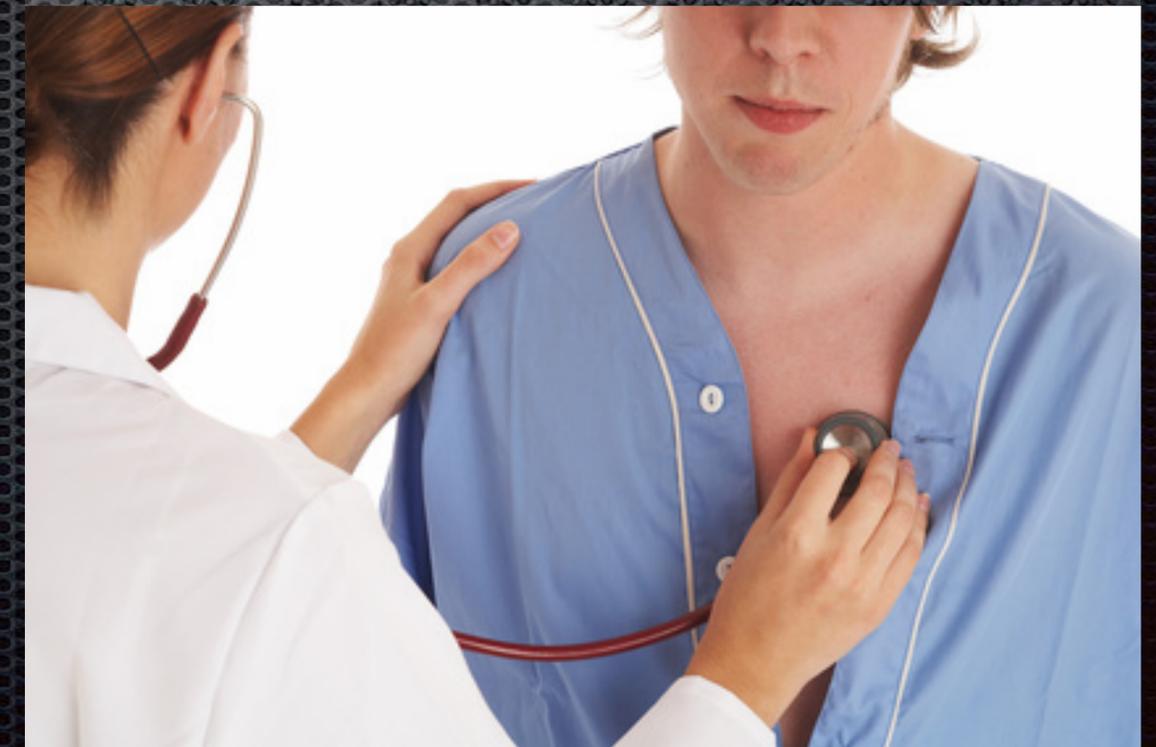
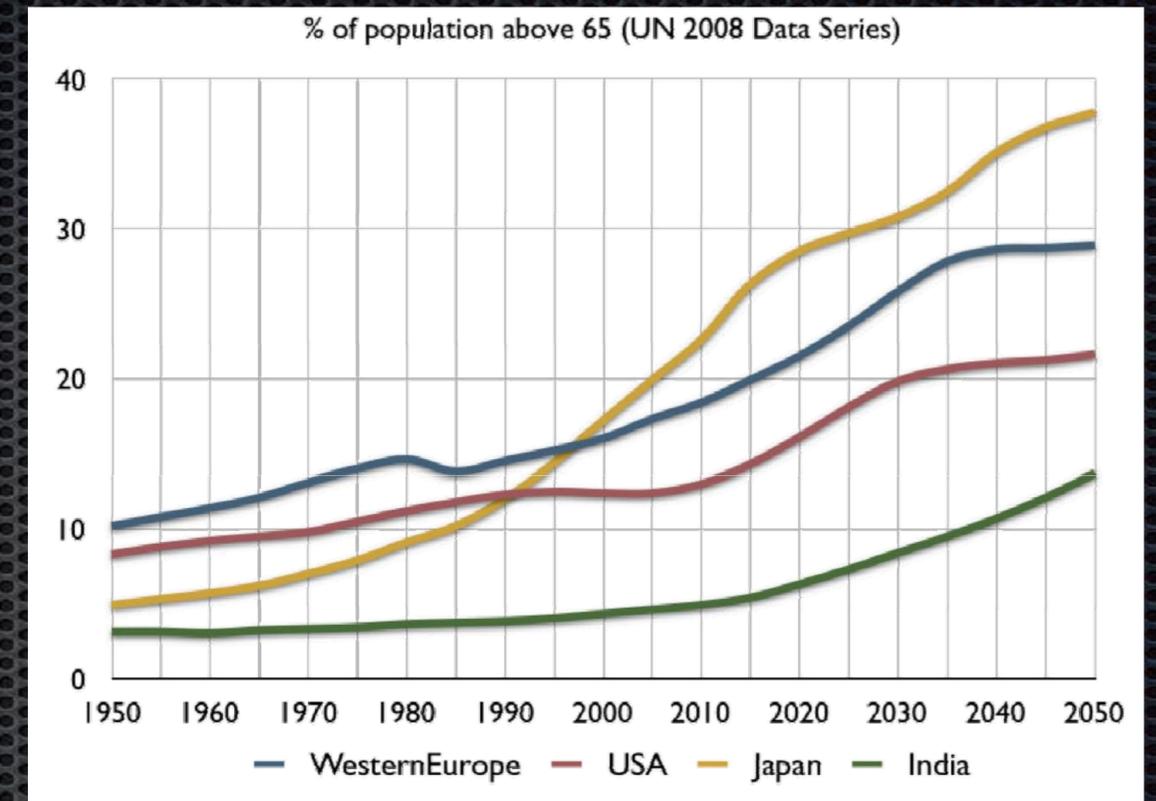
# Future Developments



- Less trauma during surgery
- Improved perception of the operating site by the surgeon
- Cost/time effectiveness
- Safety will always have to be guaranteed

# The Challenges

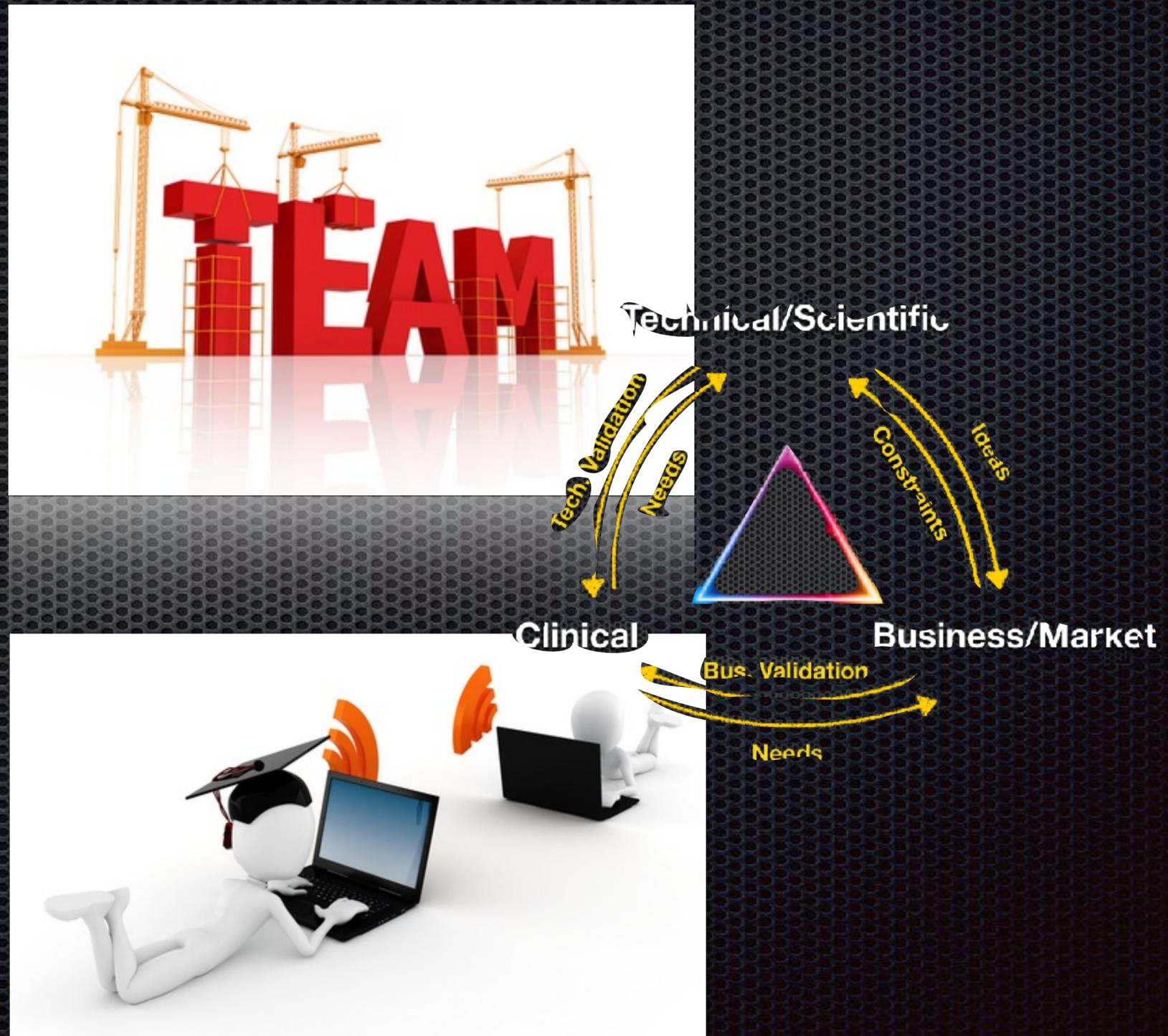
- ✦ World Population is getting Older: higher volume of clinical needs
- ✦ Costs or Clinical Needs are increasing



# The answer?

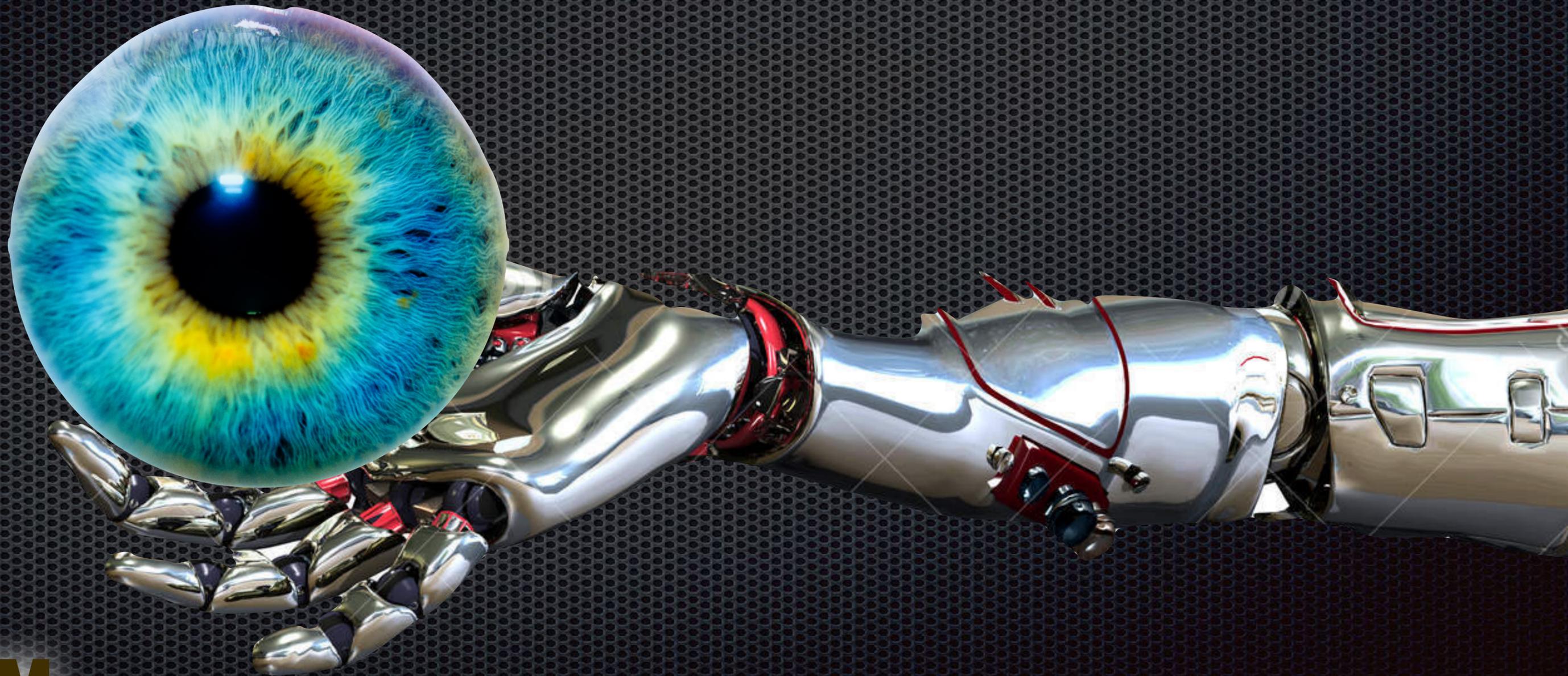
## Better Synergies

- ✦ Good Research in Multidisciplinary Collaborative Teams
- ✦ Better Working Models Specifically for Clinical Innovation
- ✦ Better Academia-Industry Collaborations



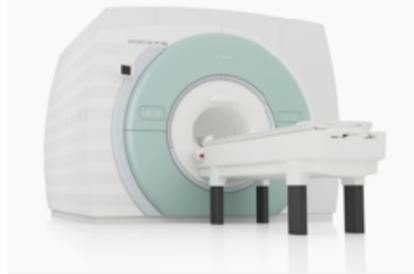
# Effective hands for beautiful eyes

*Robotics for medical imaging*





CT



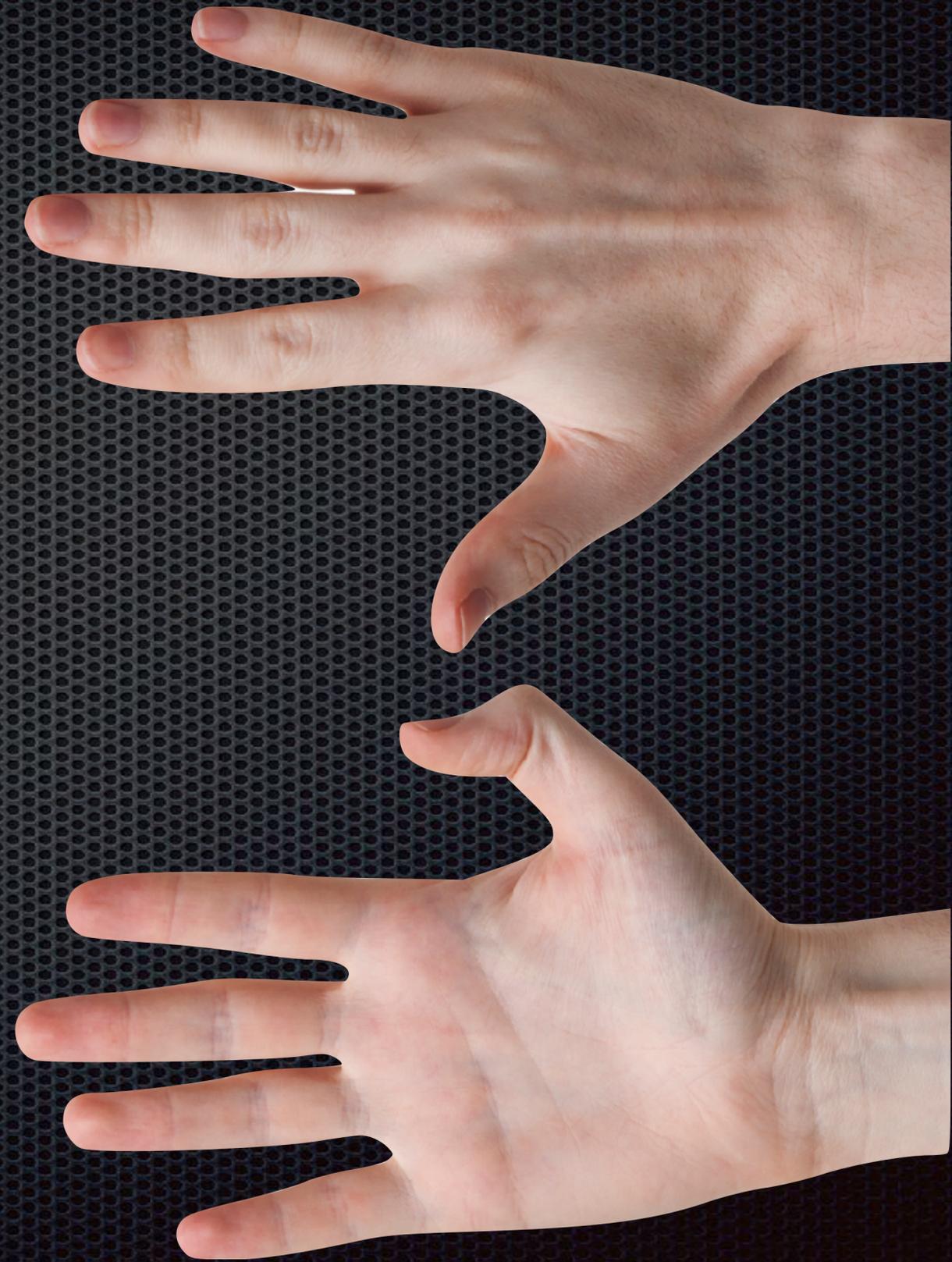
MRI



PET-MR

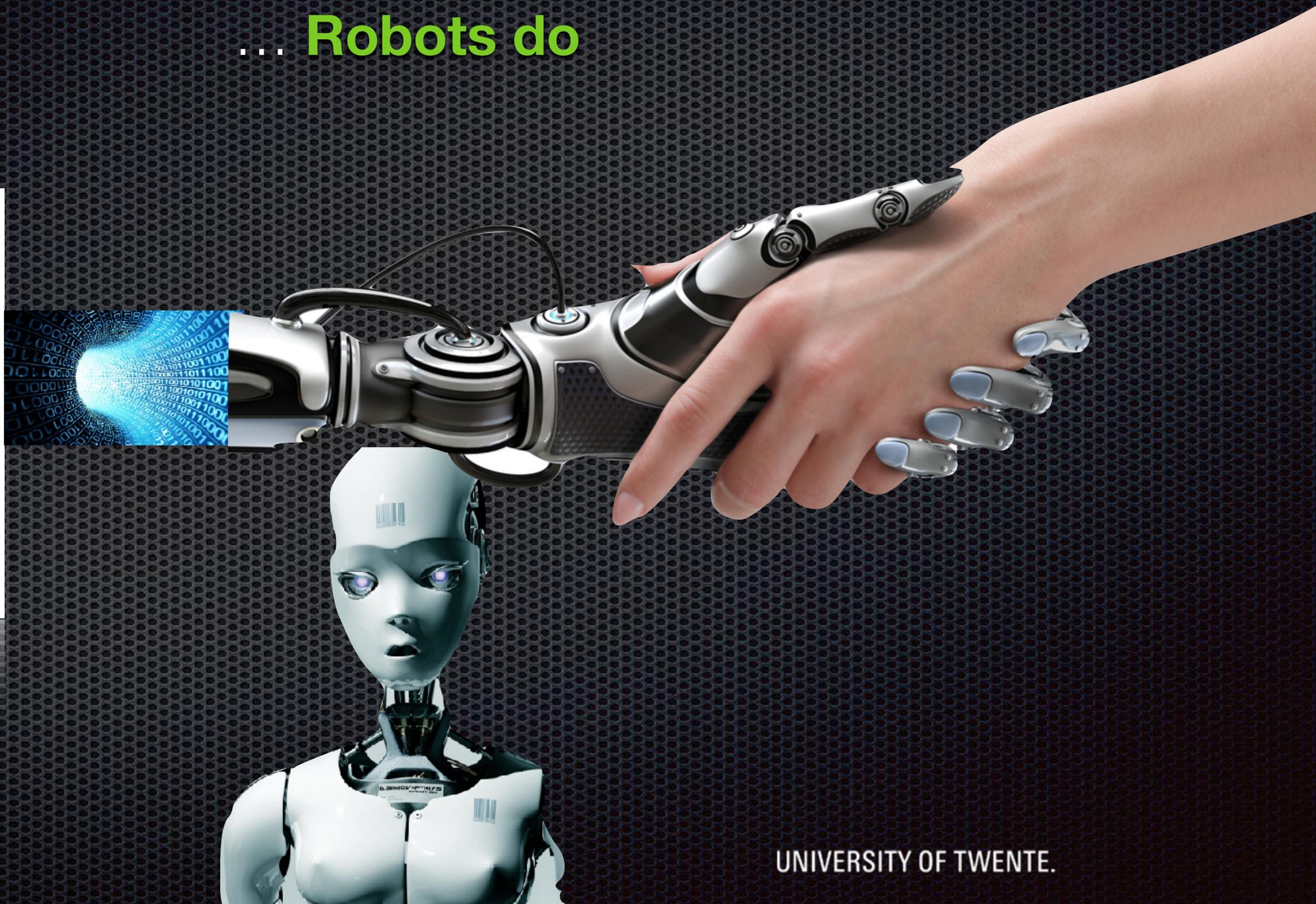


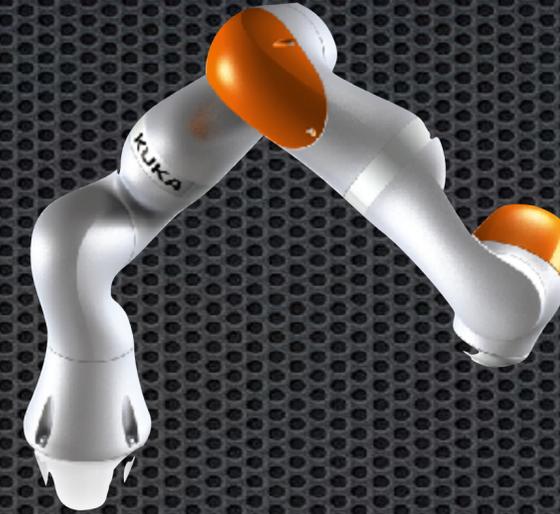
US



# Humans do not speak DIGITAL....

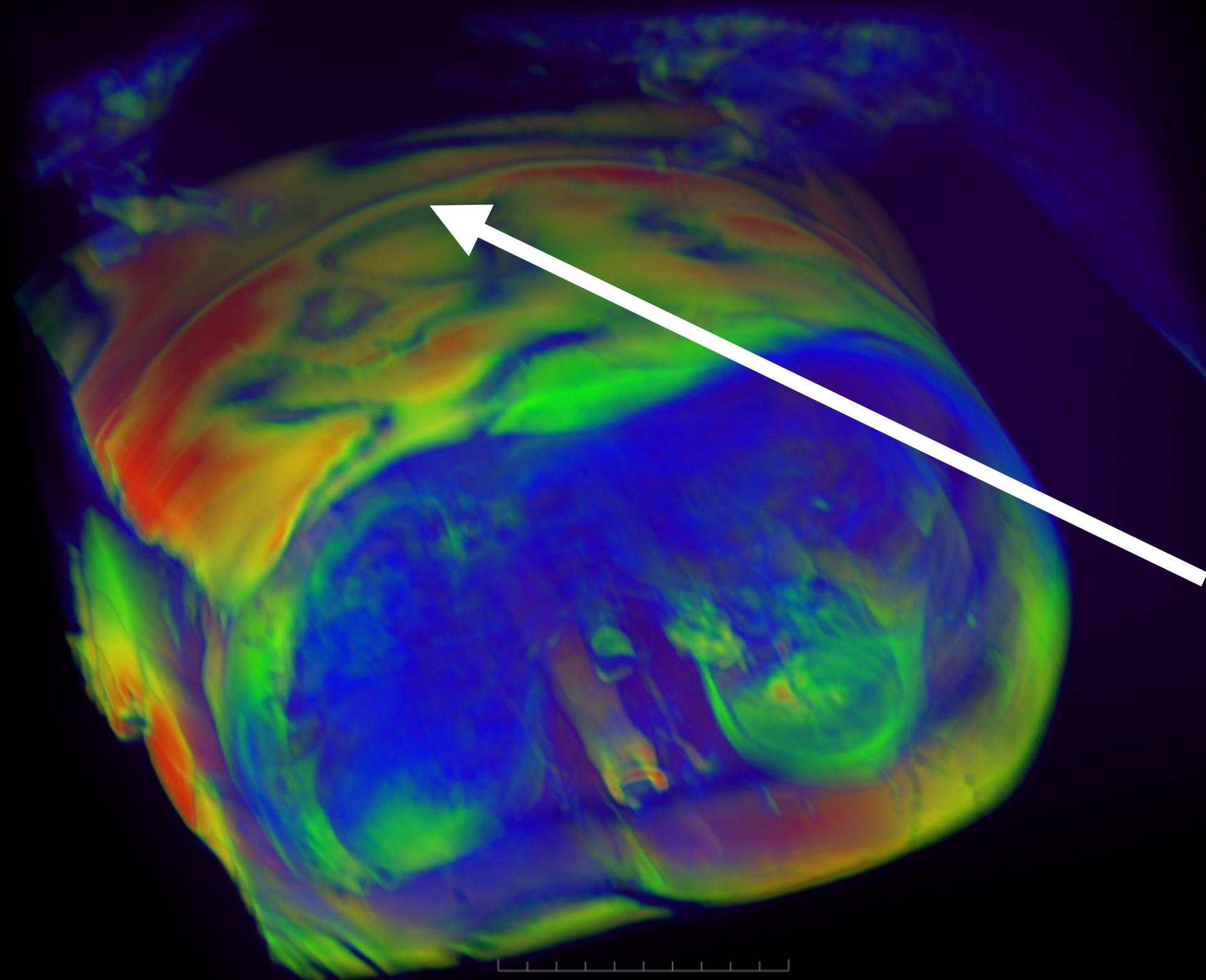
... Robots do





**Not MRI Compatible**

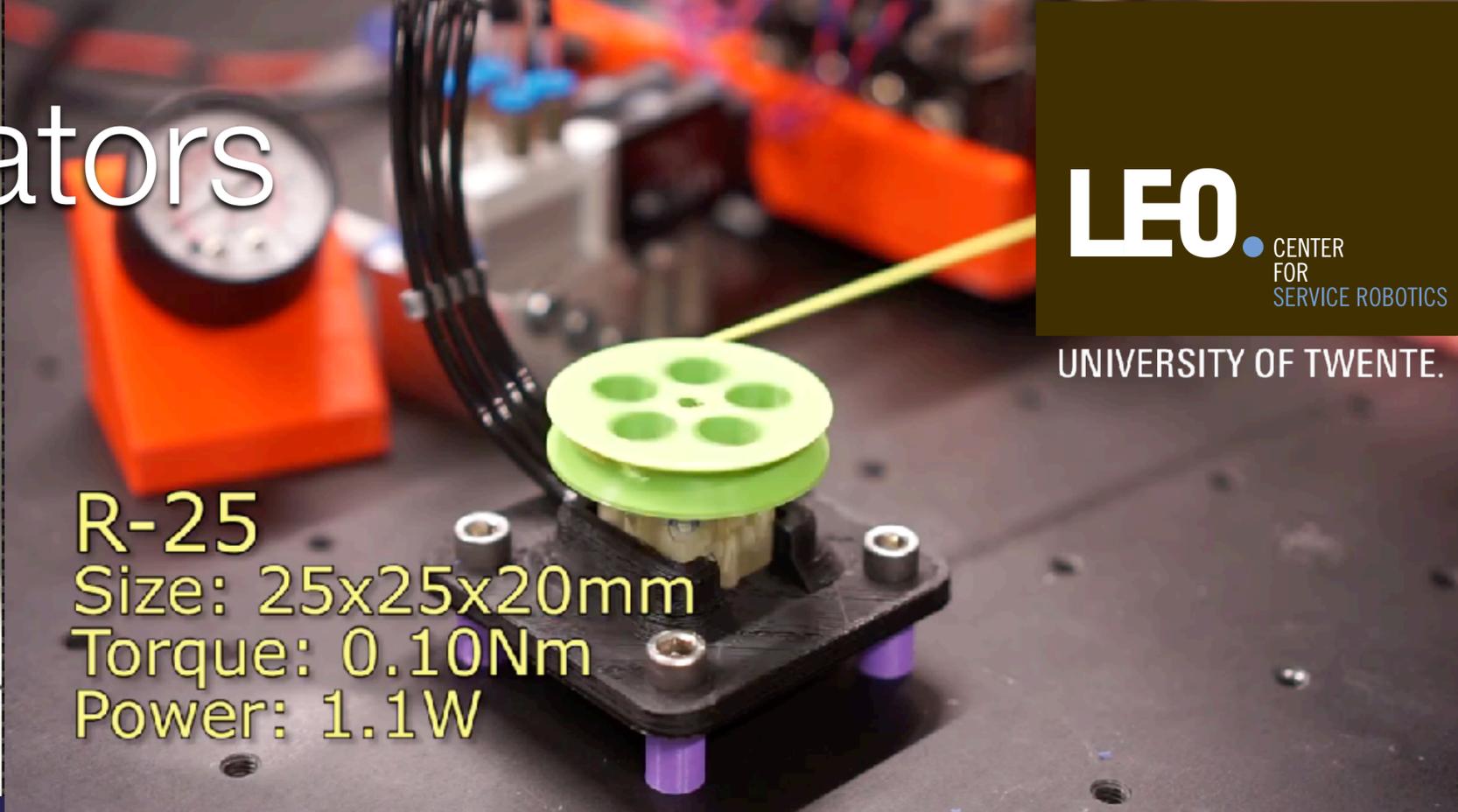
# MRI Compatible Robotics



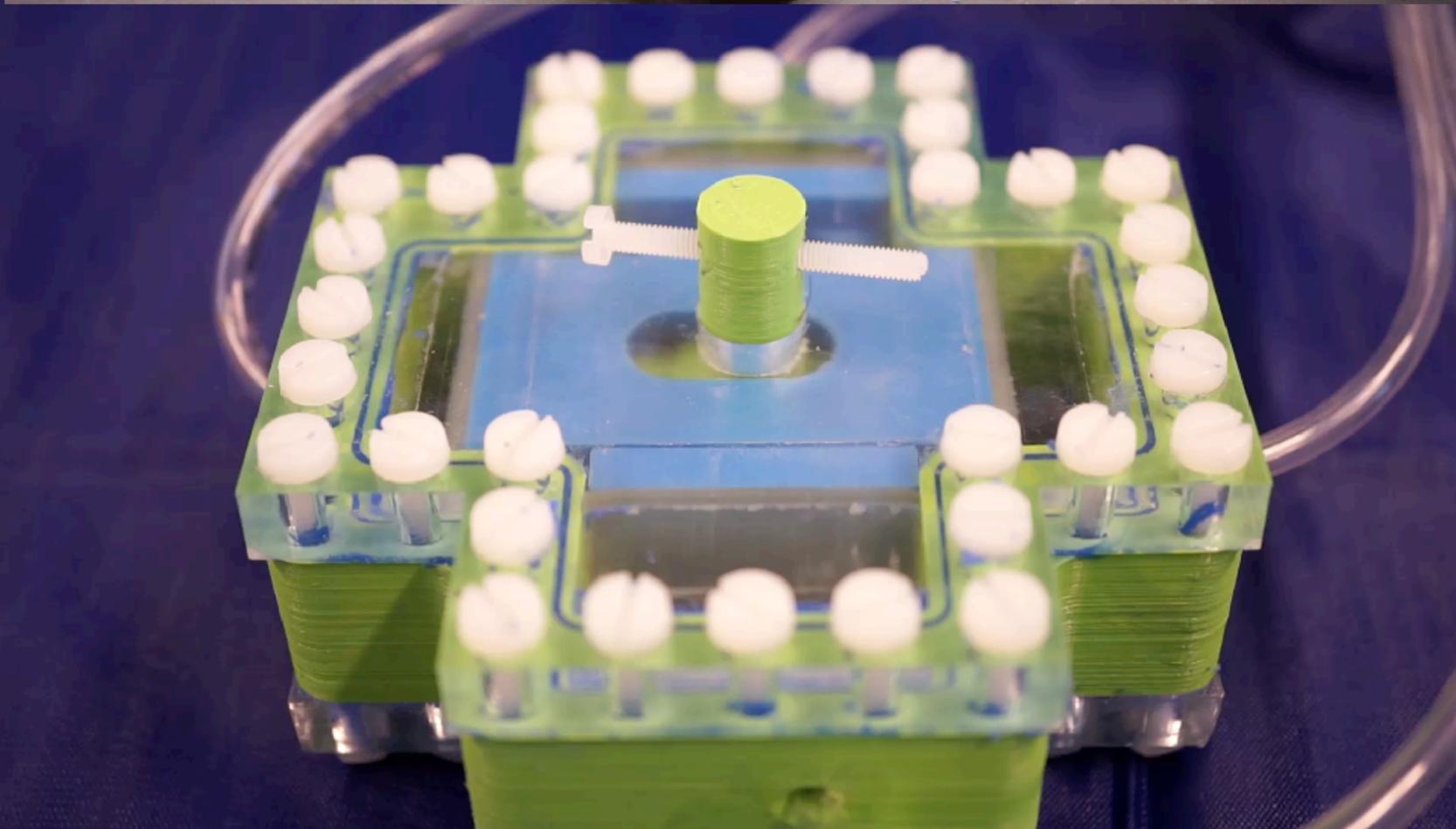
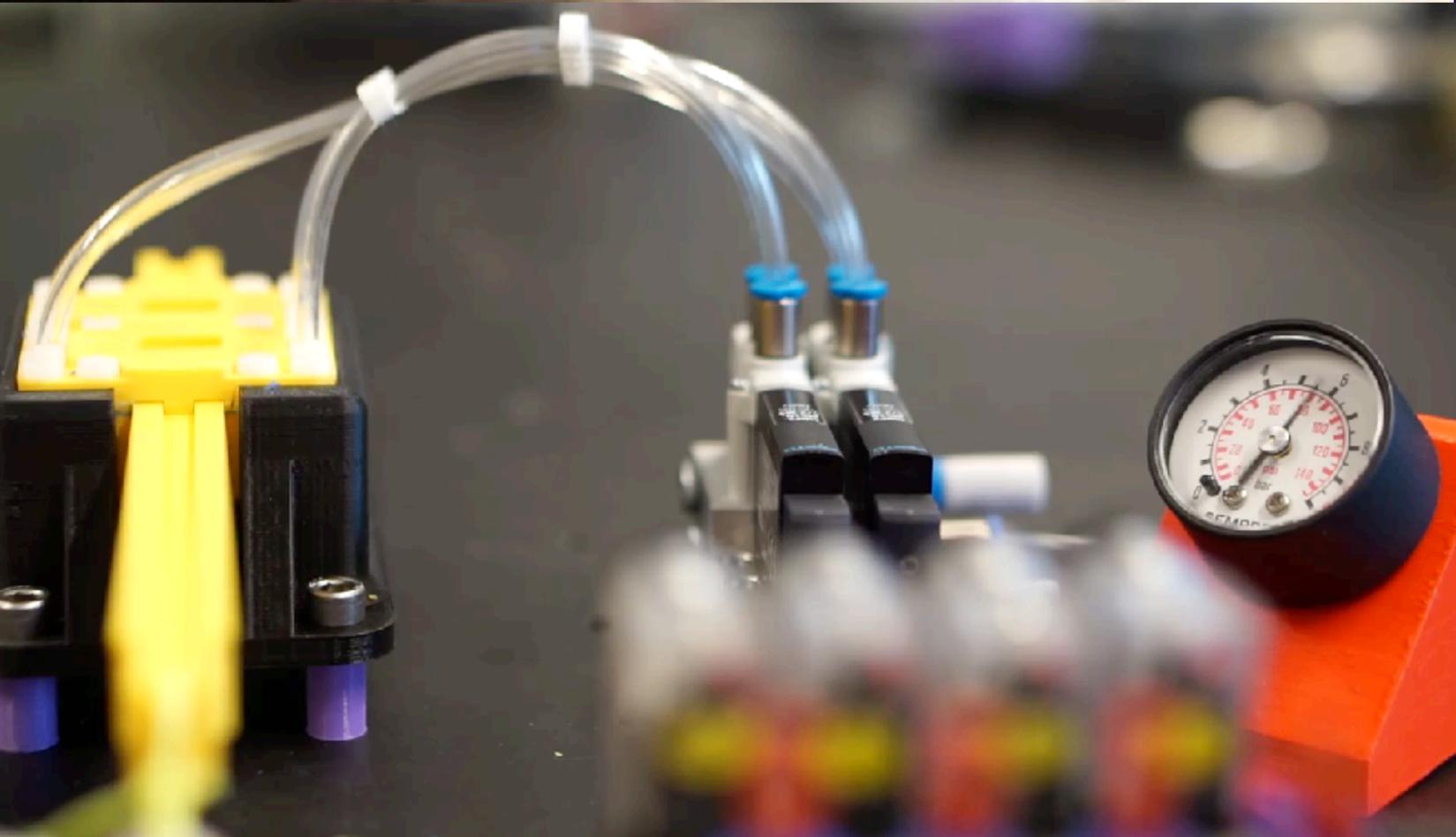
**ROBOT**



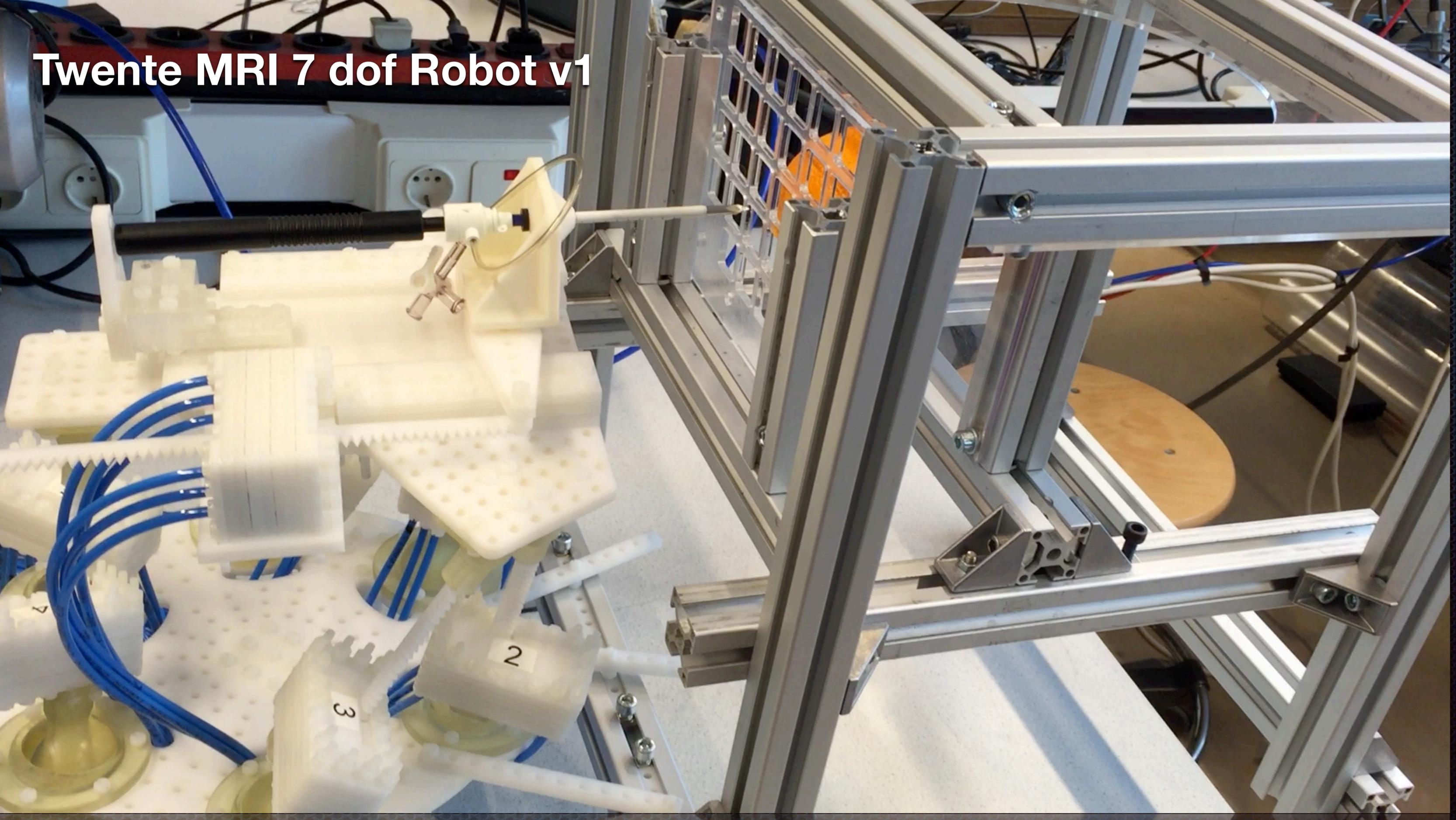
# MRI Compatible Actuators



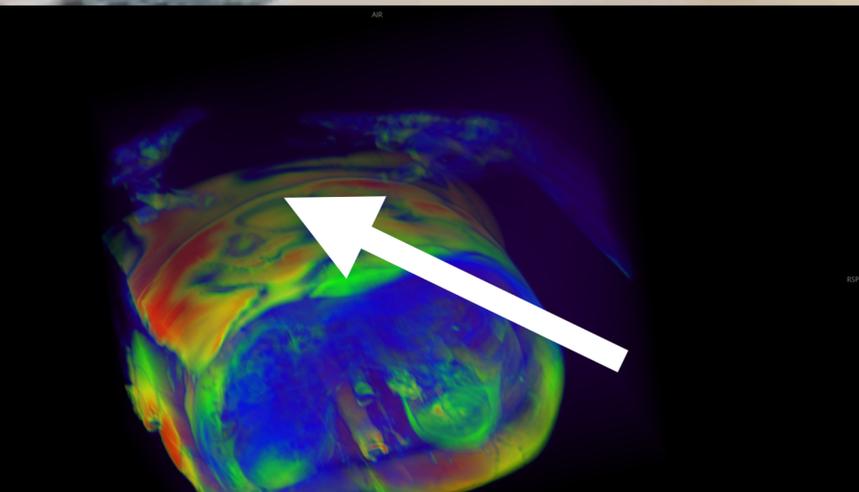
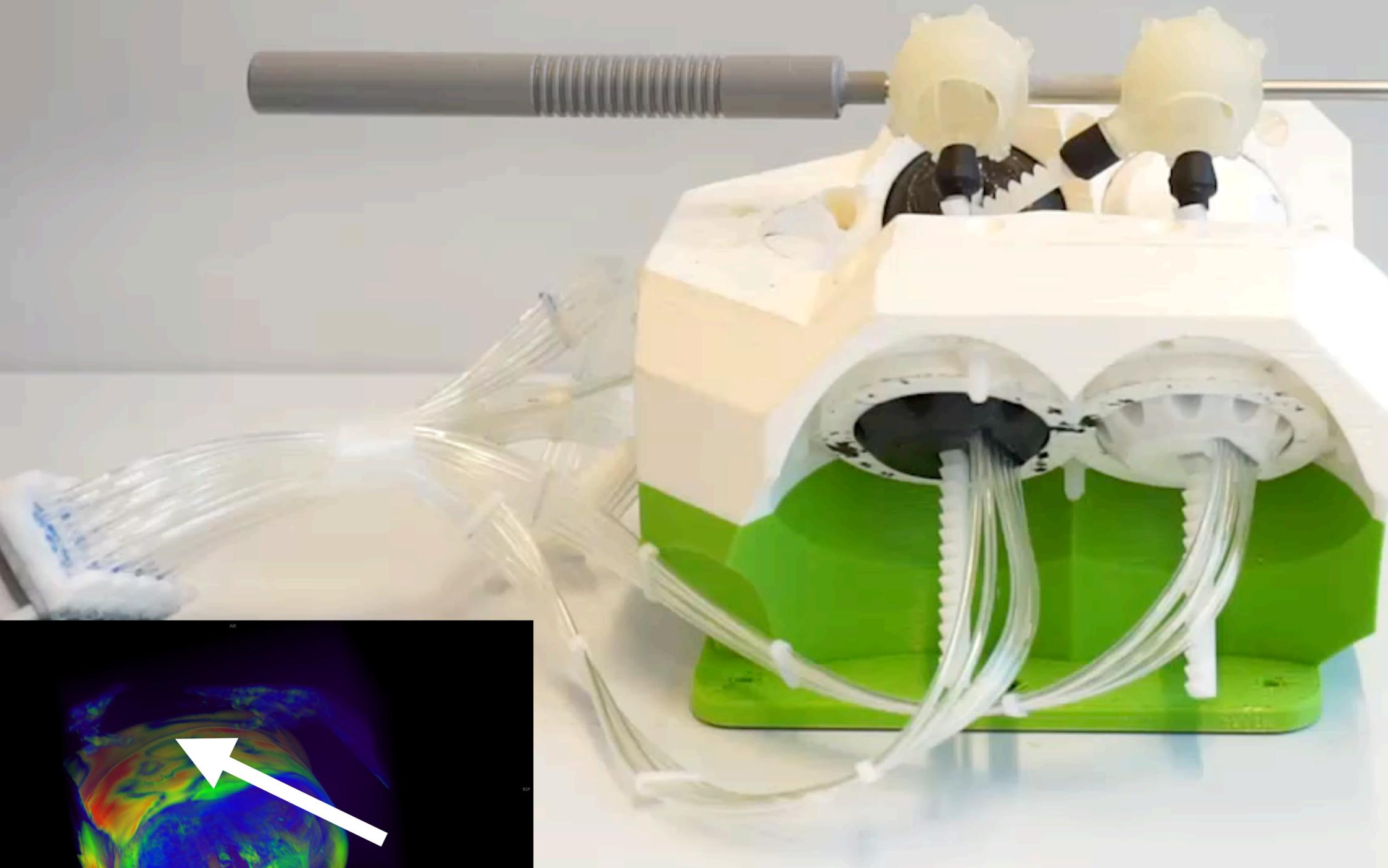
R-25  
Size: 25x25x20mm  
Torque: 0.10Nm  
Power: 1.1W



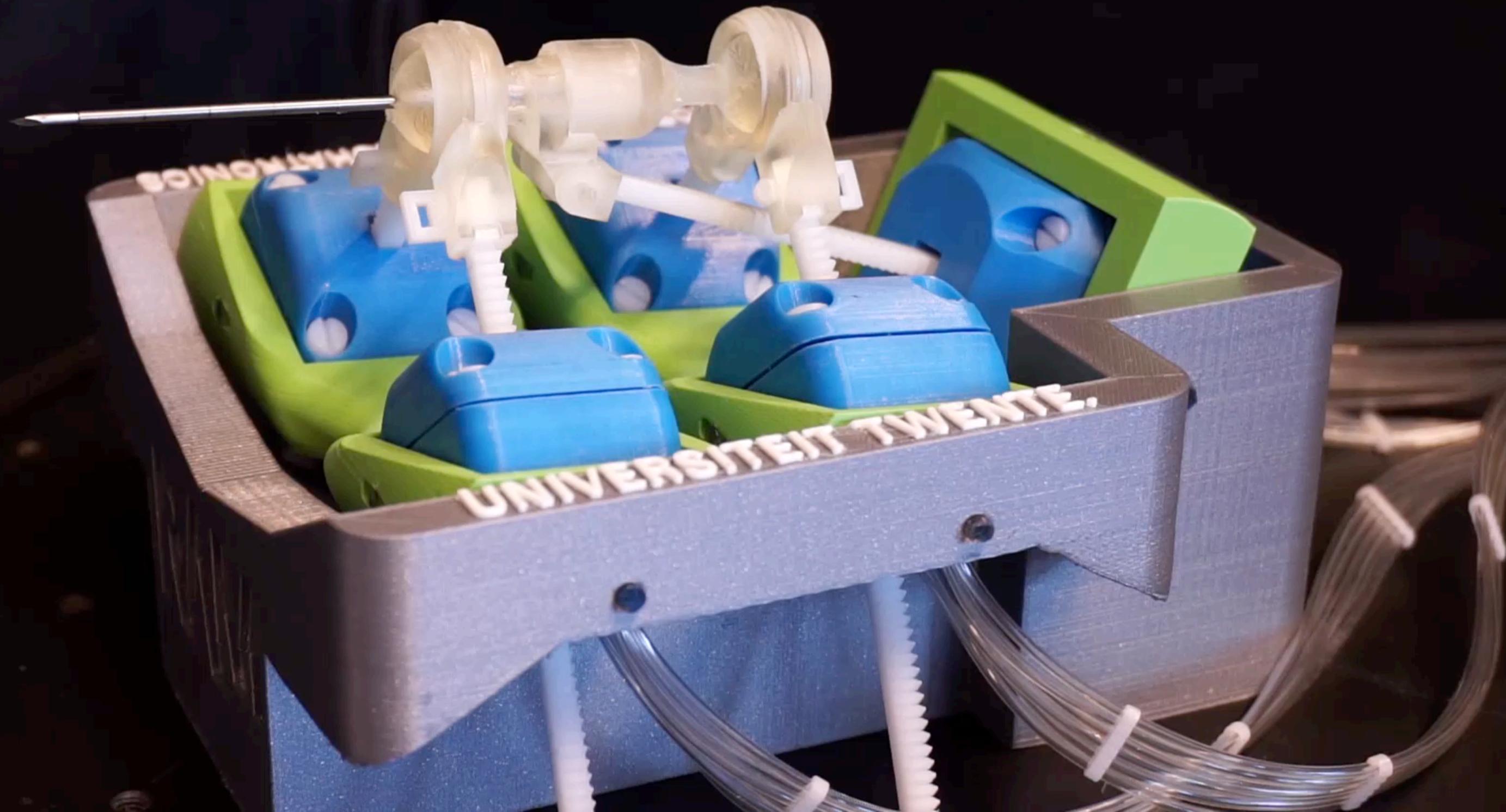
# Twente MRI 7 dof Robot v1



# Twente MRI 7 dof Robot v2



# Twente MRI 7 dof Robot v3



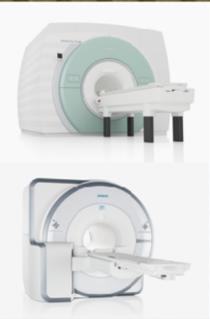
The Hamlyn Symposium  
on Medical Robotics



# Best Design Award



**Precision**



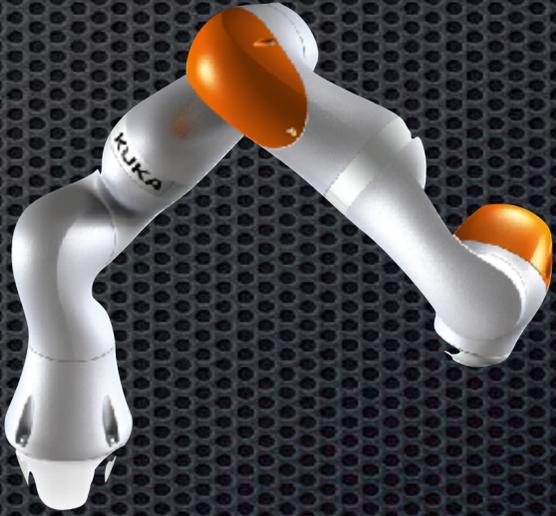

**US**



**Speed**



**Registration**



	MRI	MR-US
Speed	-	+
Radiation	+	+
Quality	+	-
Soft Tissues	+	+

# Biopsy via Image Registration

# MURAB

*MRI and Ultrasound Robotic Assisted Biopsy*



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**KUKA**

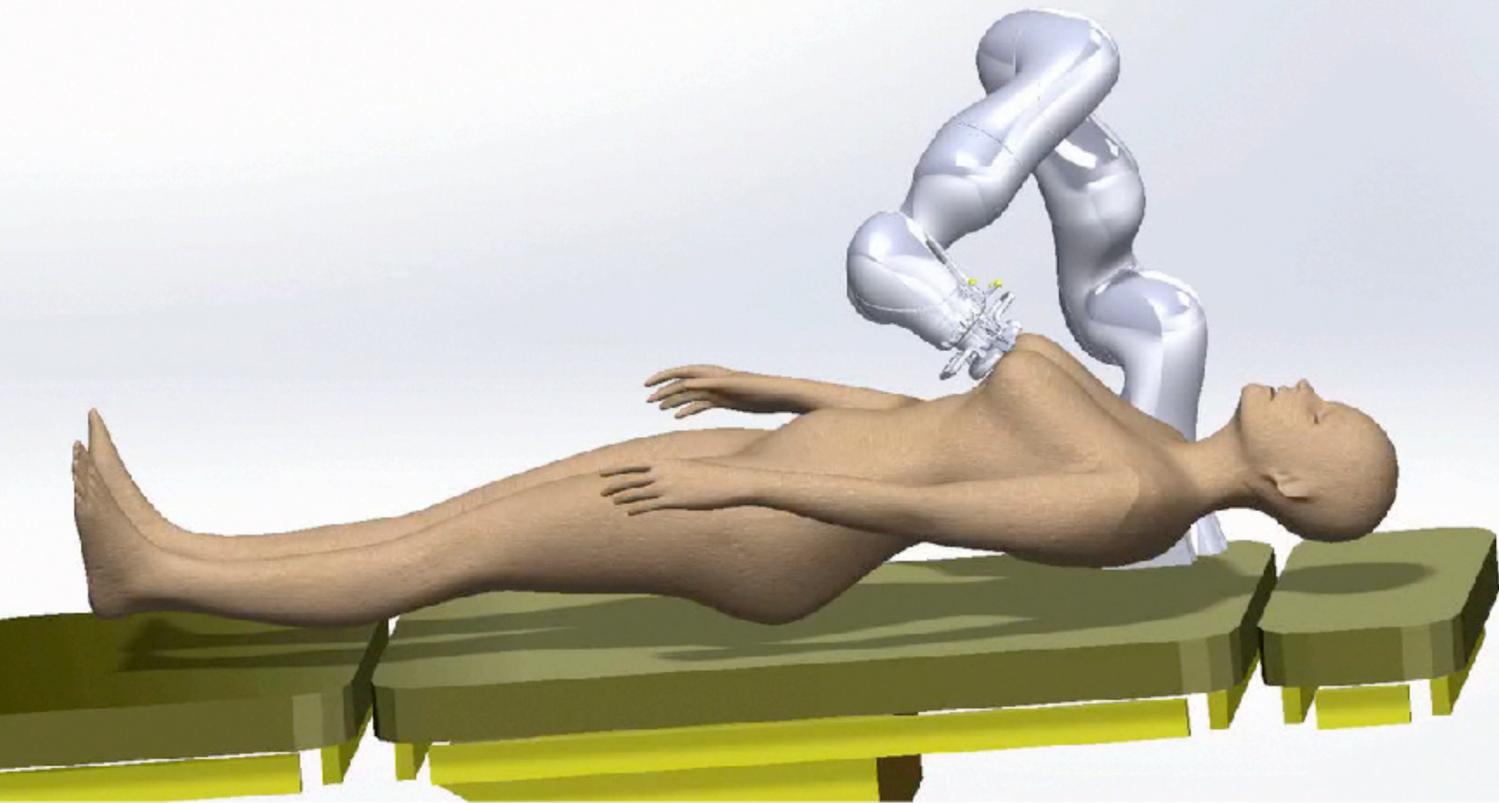
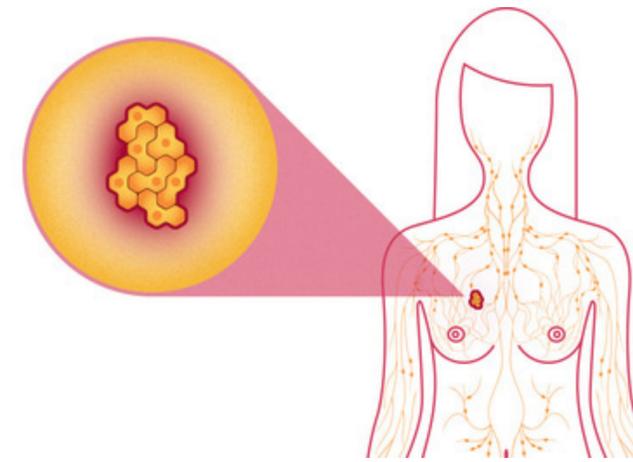


Radboudumc

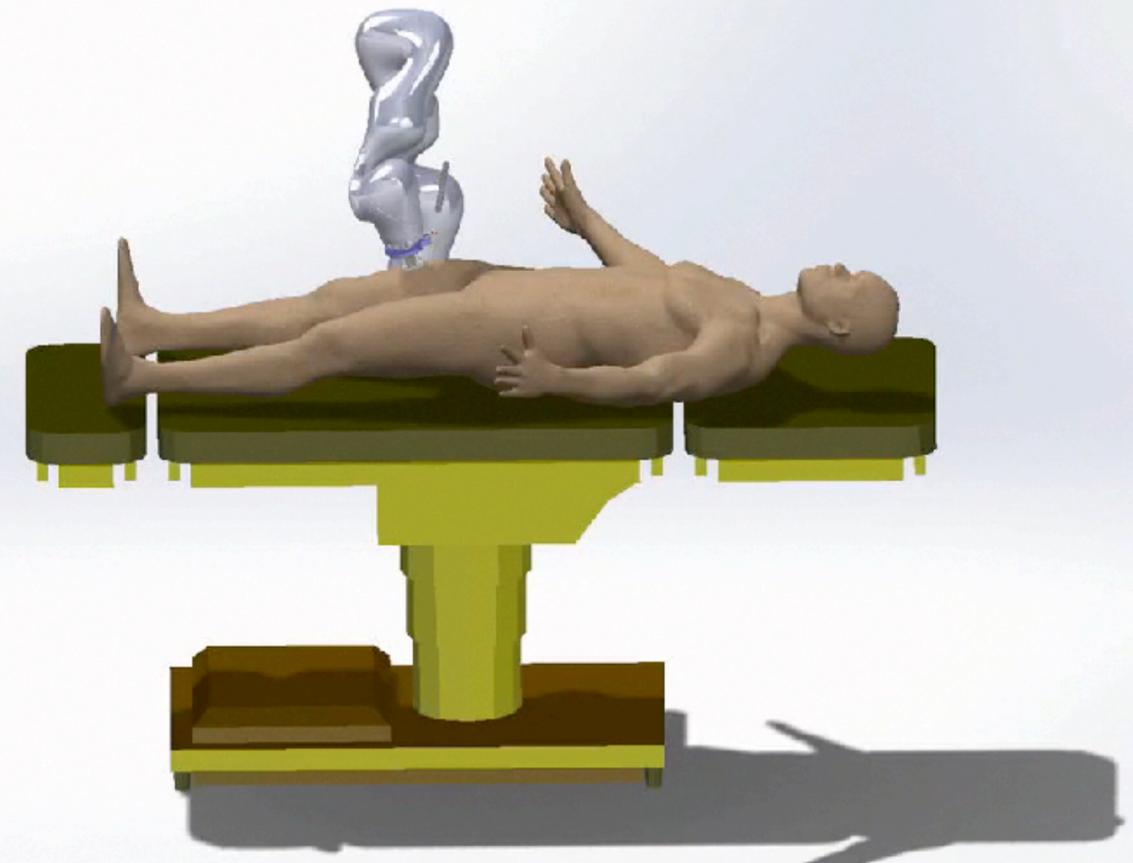
**SIEMENS**

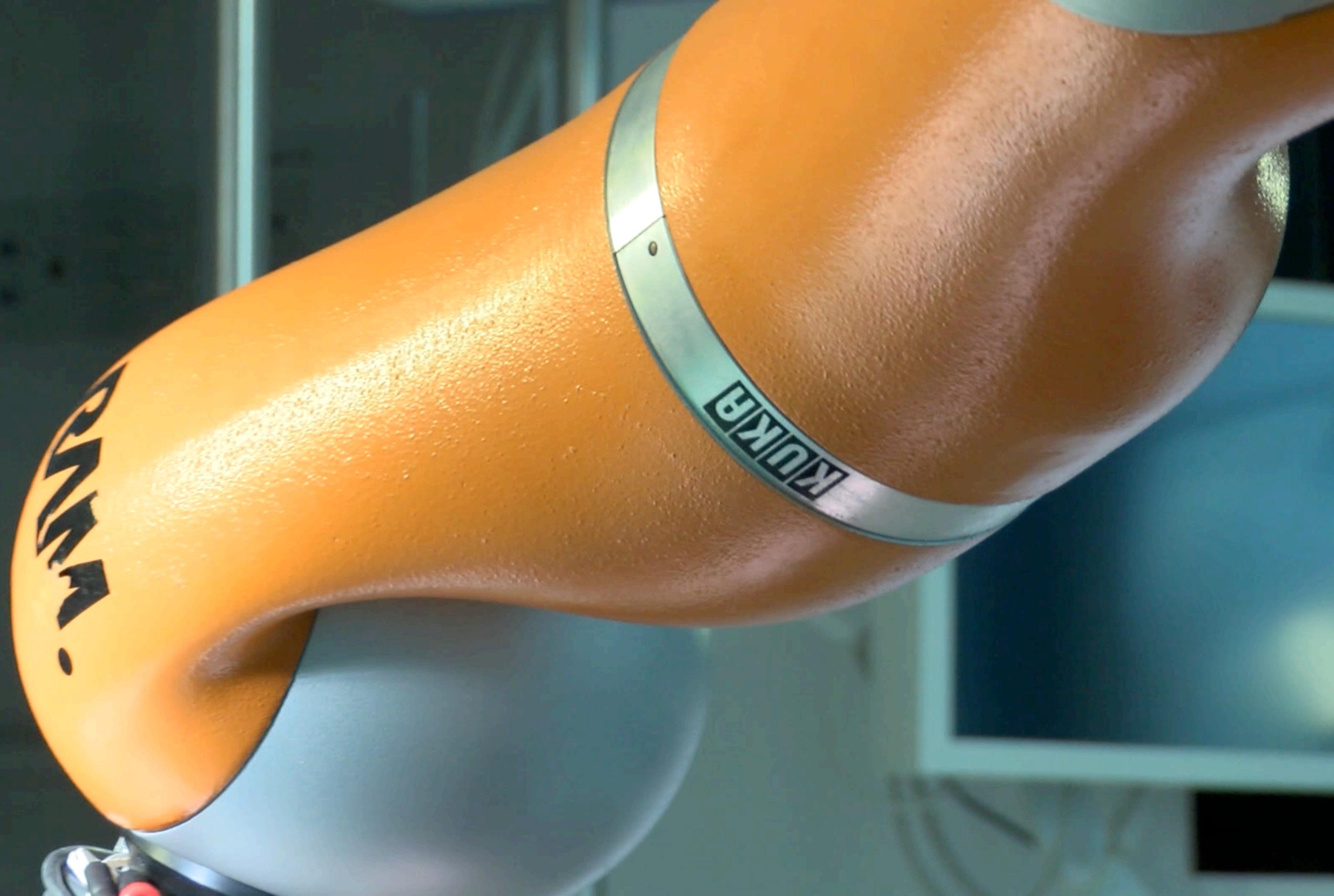


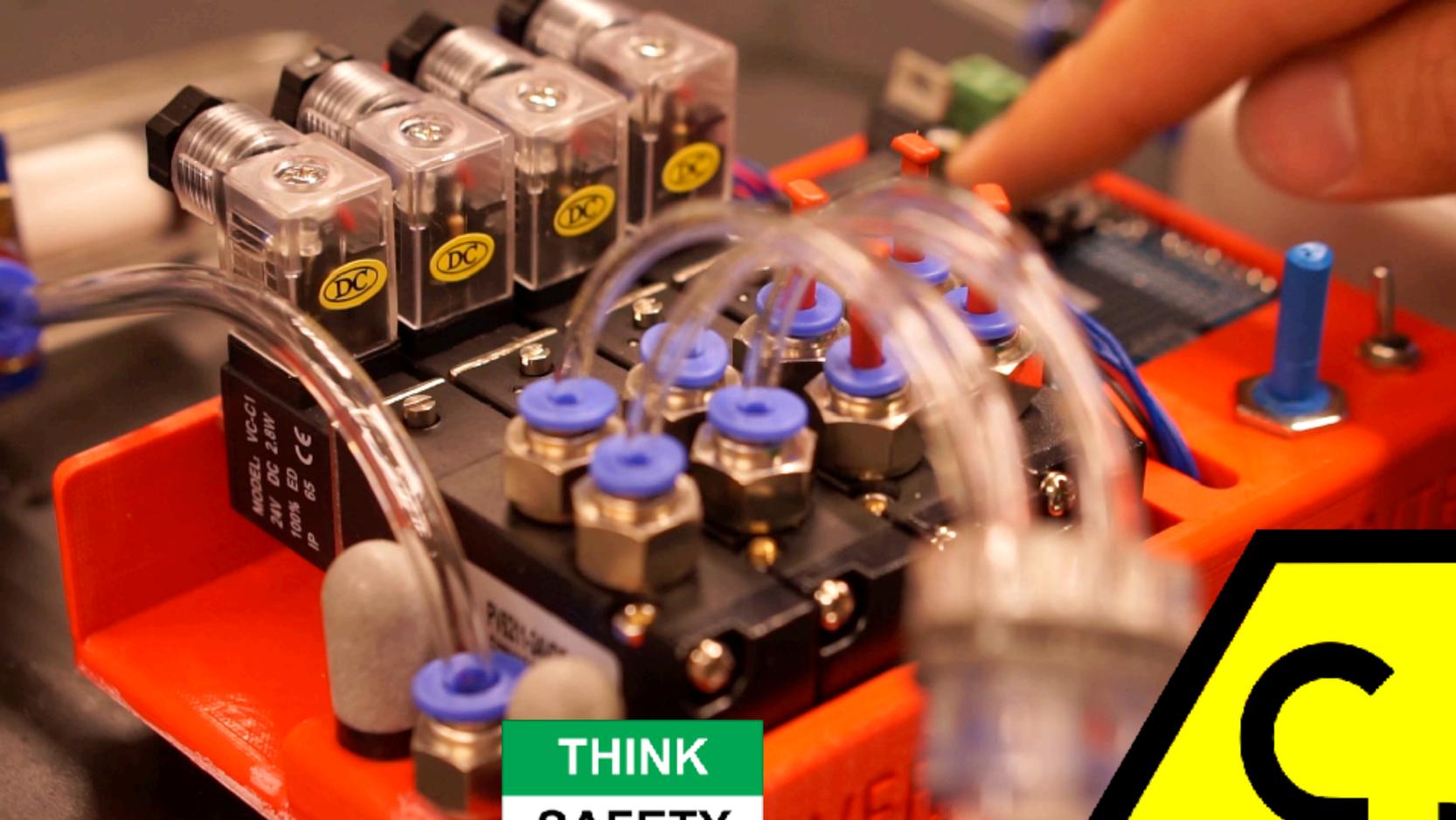
# Breast Cancer



Muscle Disease







**THINK  
SAFETY  
FIRST**

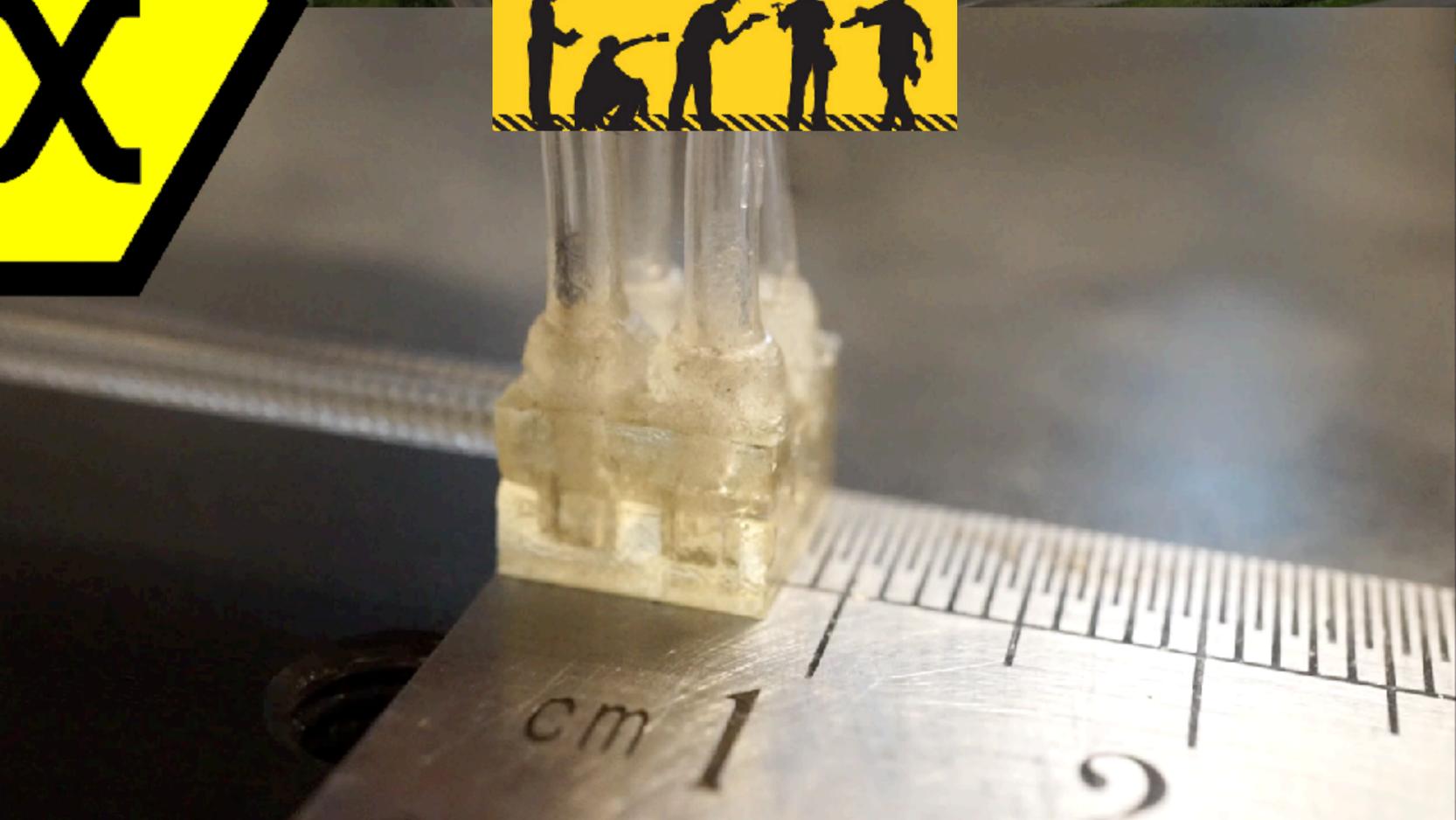
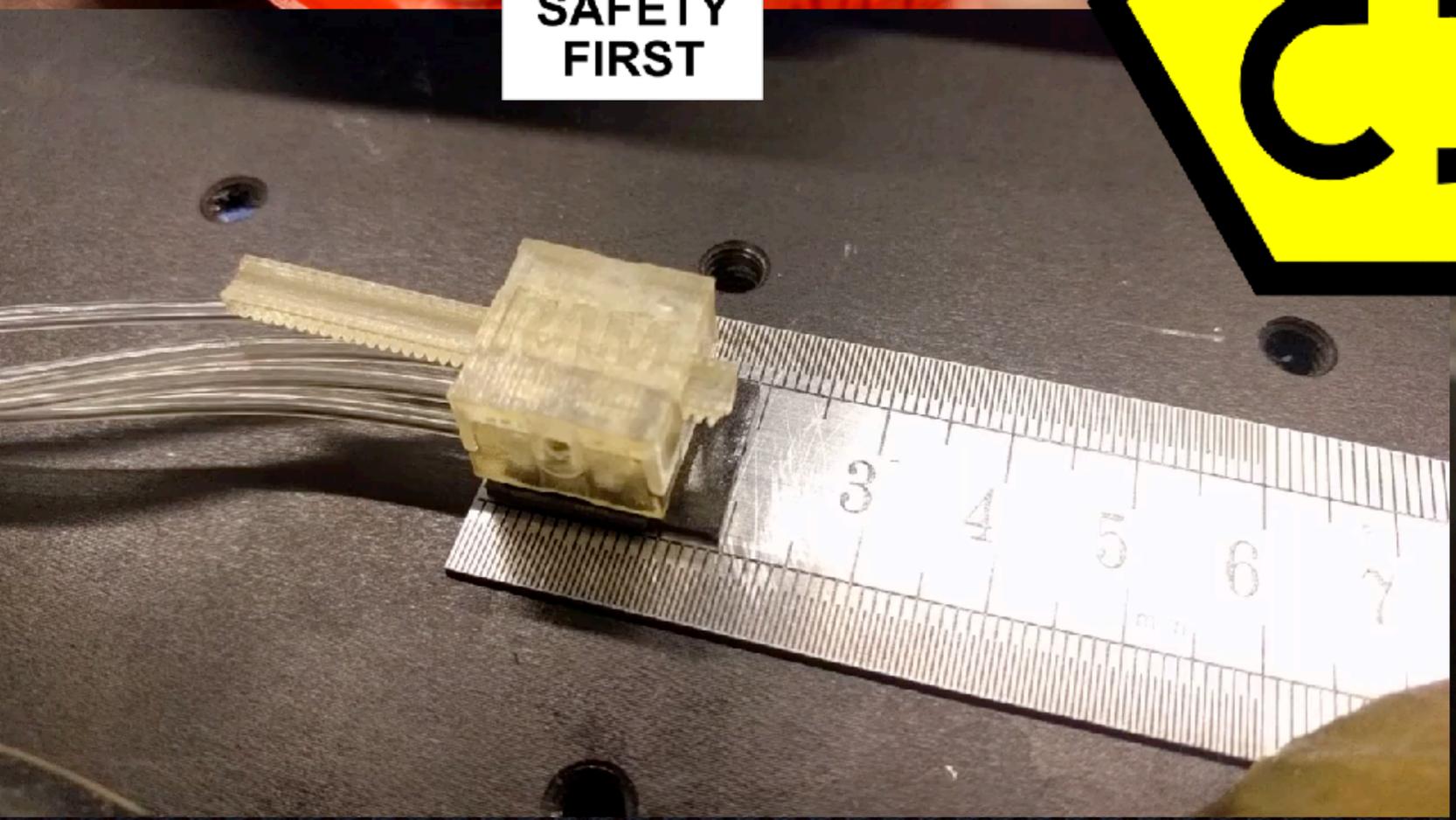


SPACE<sup>53</sup>

> the unmanned  
ambition



i-BOTICS



*The sky is **not** the limit,  
..but just the first layer*

**THANK YOU FOR YOUR ATTENTION**

