

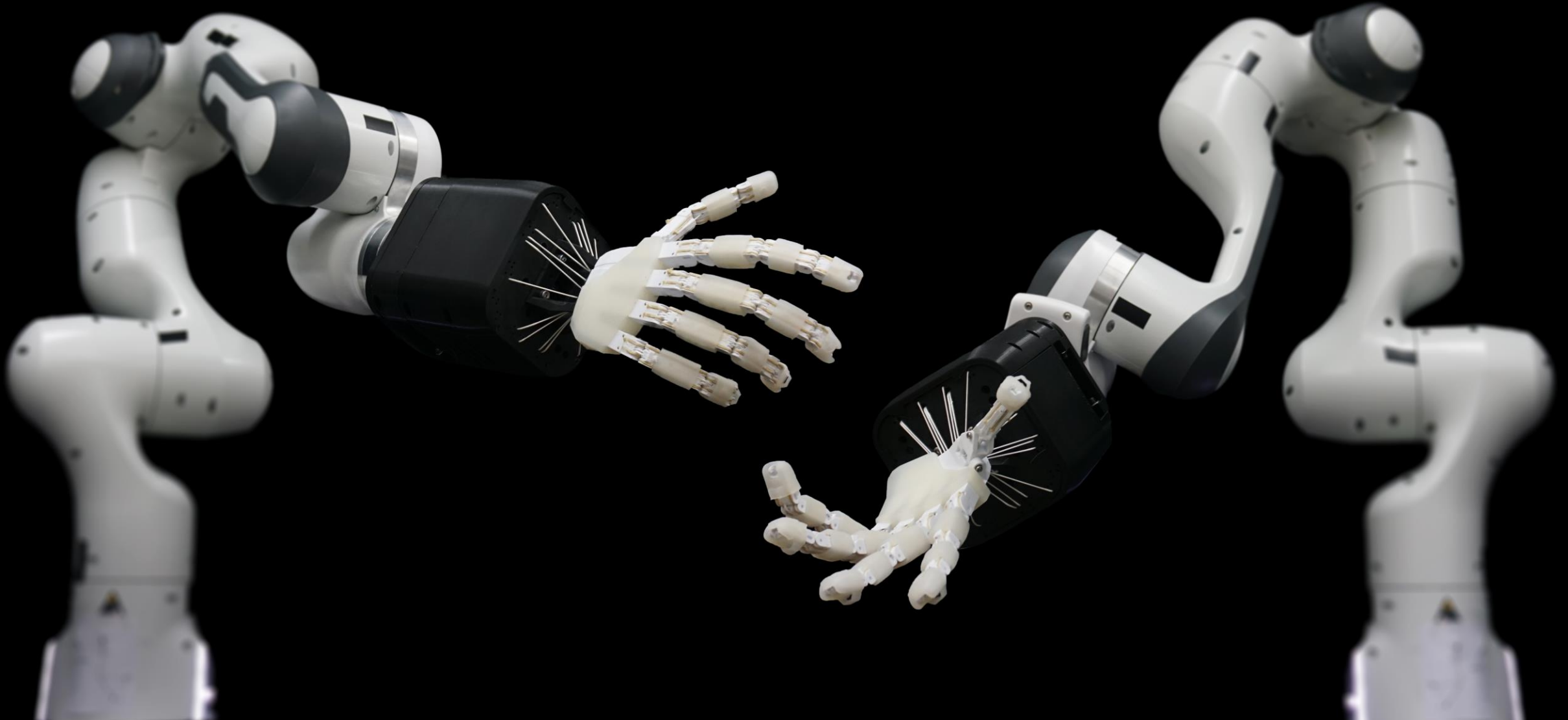


# The Challenge - Robotics Hands for Dexterous Manipulation Focus & Q&A Talk #1

Prof. Dr. Robert Katzschmann  
Soft Robotics Lab  
ETH Zurich



Shall future AI do your art and writing or rather your laundry and dishes?





Make an image on: A cat wearing sunglasses by the lake

Please write me a short poem.



Of course! Here's a brief poem for you:

### **Silent Bloom**

In quiet moments, flowers grow,  
Whispers of the earth below.  
In a breath, the world is new,  
Bathed in morning's gentle hue.

I hope this captures what you're looking for!

“

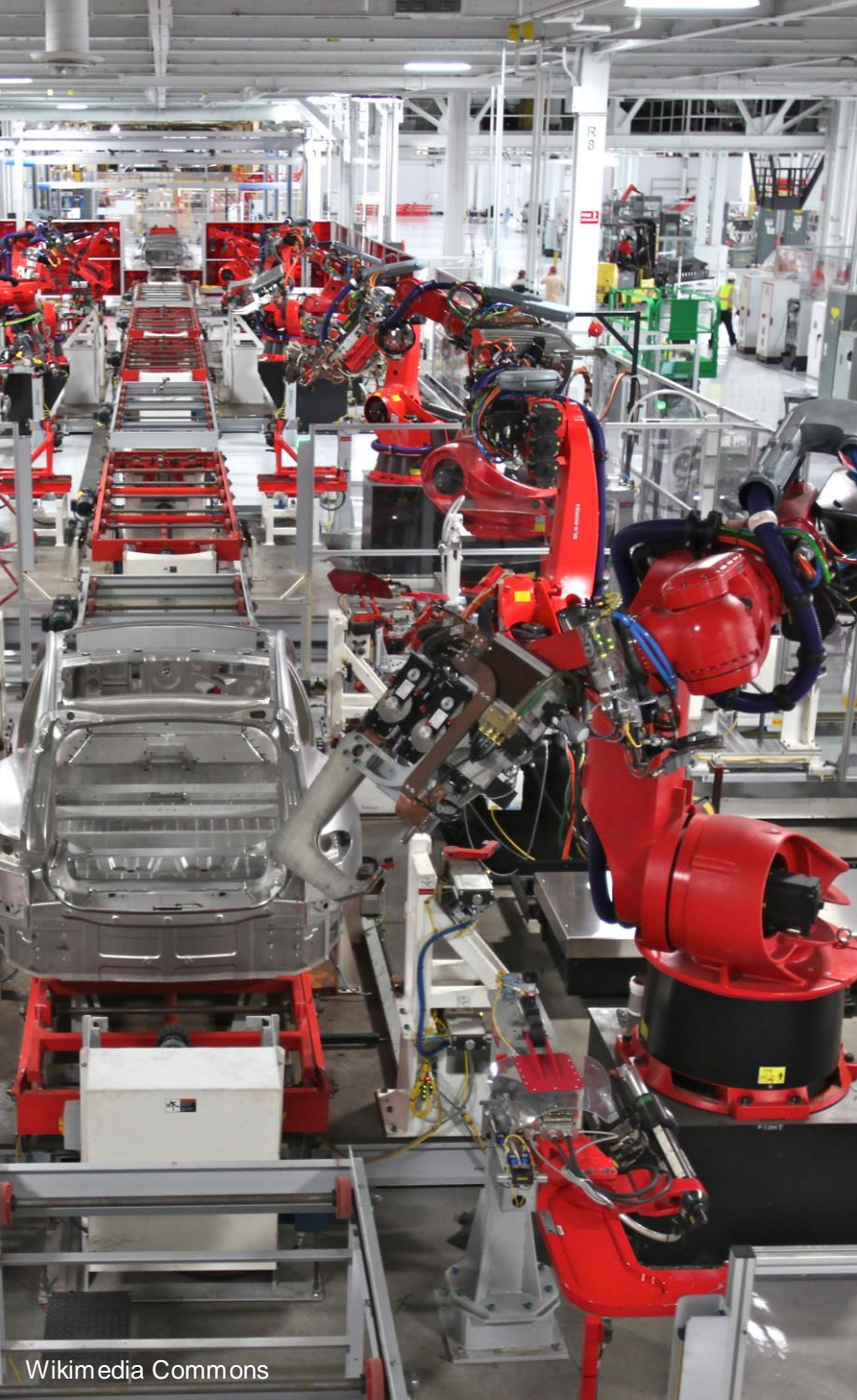
I want **AI** to do my **laundry** and **dishes** so that I can do **art** and **writing**,

Not for **AI** to do my **art** and **writing** so that I can do my **laundry** and **dishes**.

”

- Joanna Maciejewska





Wikimedia Commons



Kindel Media



ANYbotics



Wallpaper Flare



Wallpaper Flare



PxHere



Wikimedia Commons











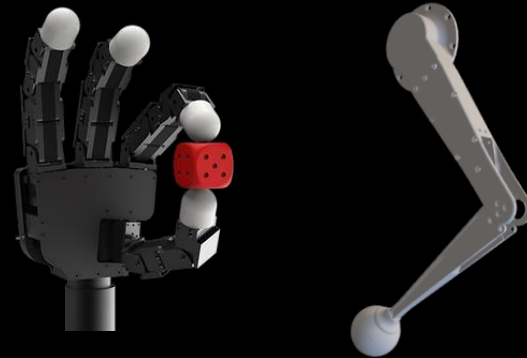


# Musculoskeletal designs bring together multiple worlds

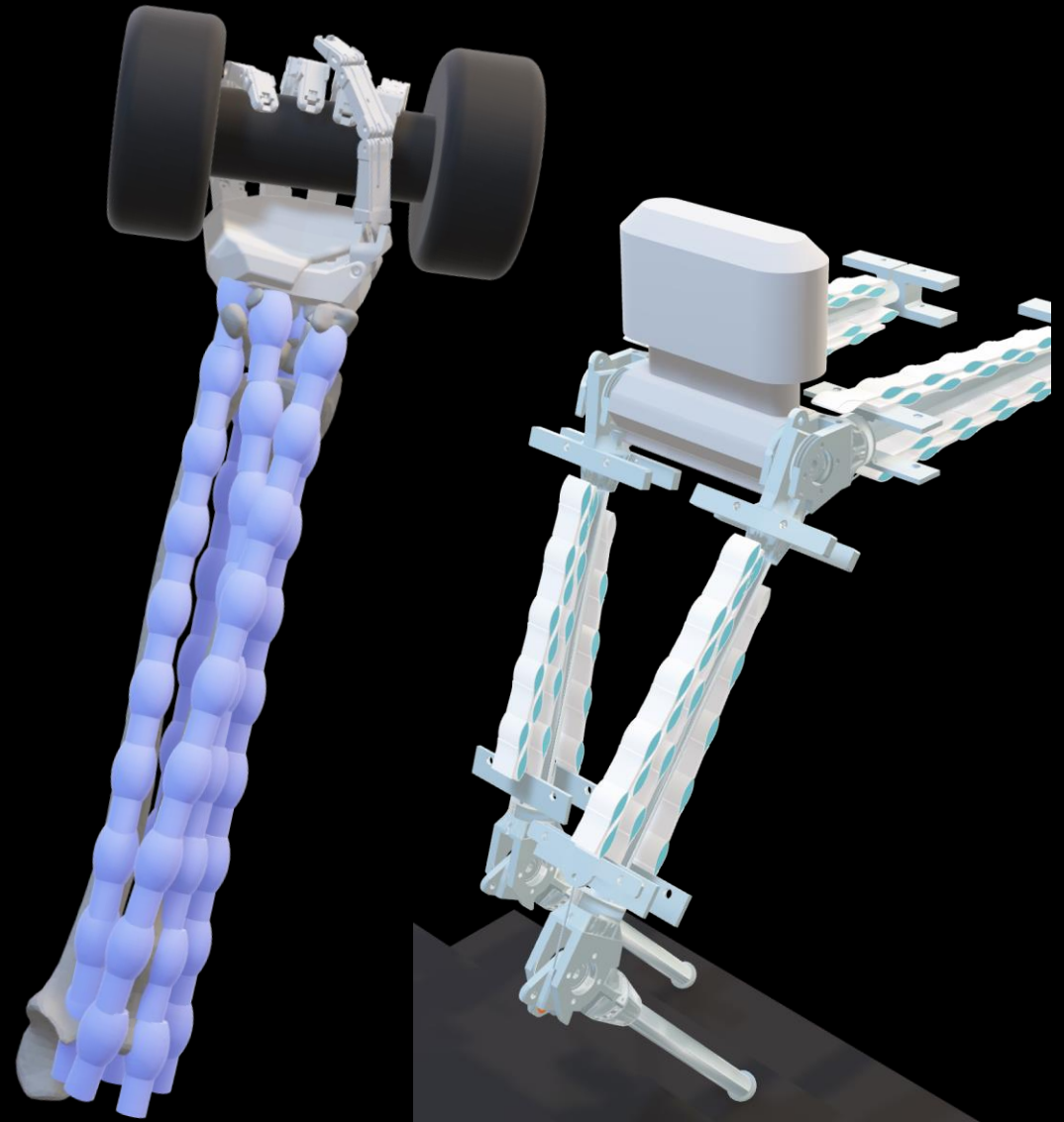
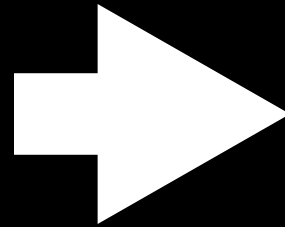
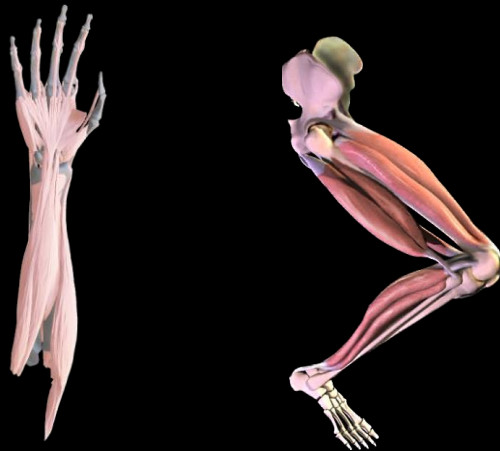
Soft



Rigid

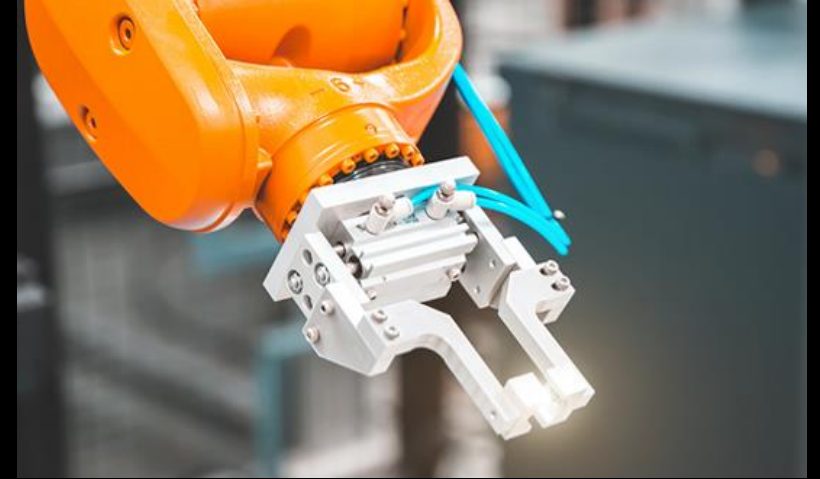


Nature



# The Problem

## Task Specific Grippers



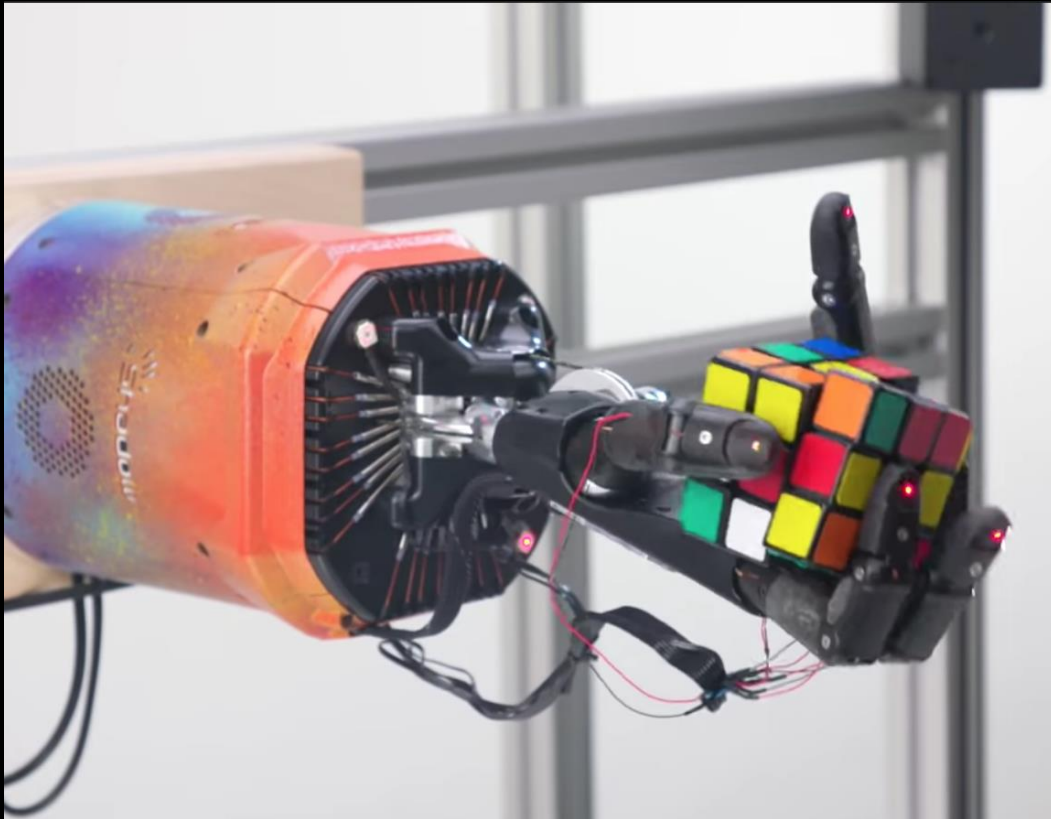
# Market

## Complex Manual Labour Tasks



# The Problem

## Humanoid Robotic Hands



Shadow Robot Hand 186k €



Robotiq 3-finger gripper 15k €



2x Volkswagen Golf 28.6k €



Porsche 911 Carrera 113.5k €

Akkaya, I., Andrychowicz, M., Chociej, M., Litwin, M., McGrew, B., Petron, A., ... & Zhang, L. (2019). Solving rubik's cube with a robot hand. *arXiv preprint arXiv:1910.07113*.  
[https://www.youtube.com/watch?v=kVmp0uGtShk&ab\\_channel=OpenAI](https://www.youtube.com/watch?v=kVmp0uGtShk&ab_channel=OpenAI)

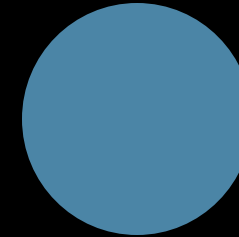


# Existing Solutions

## Versatility, Ease-of-Use and Rapid Learning at a Fraction of the Cost



Easy-to-use

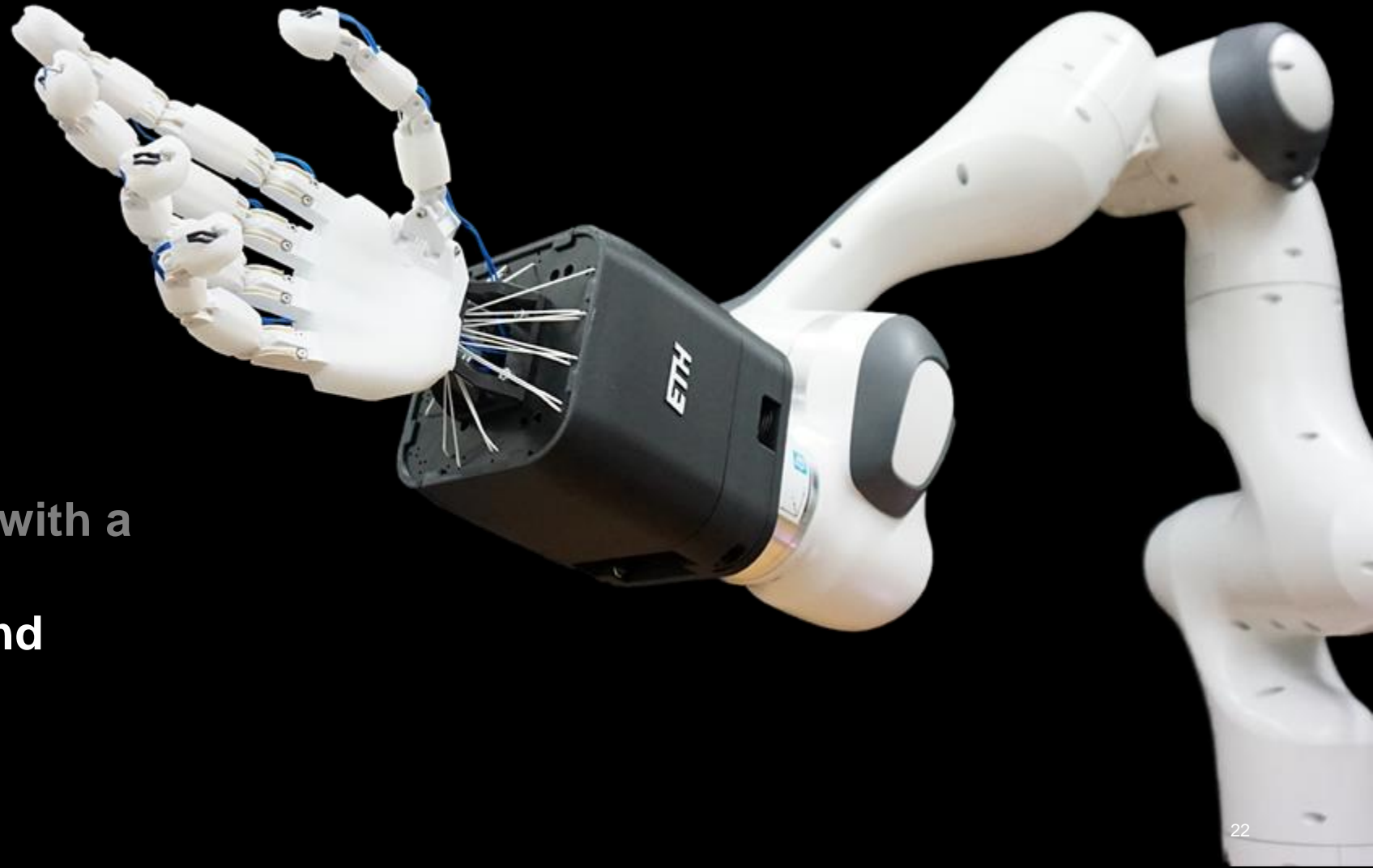


Limited

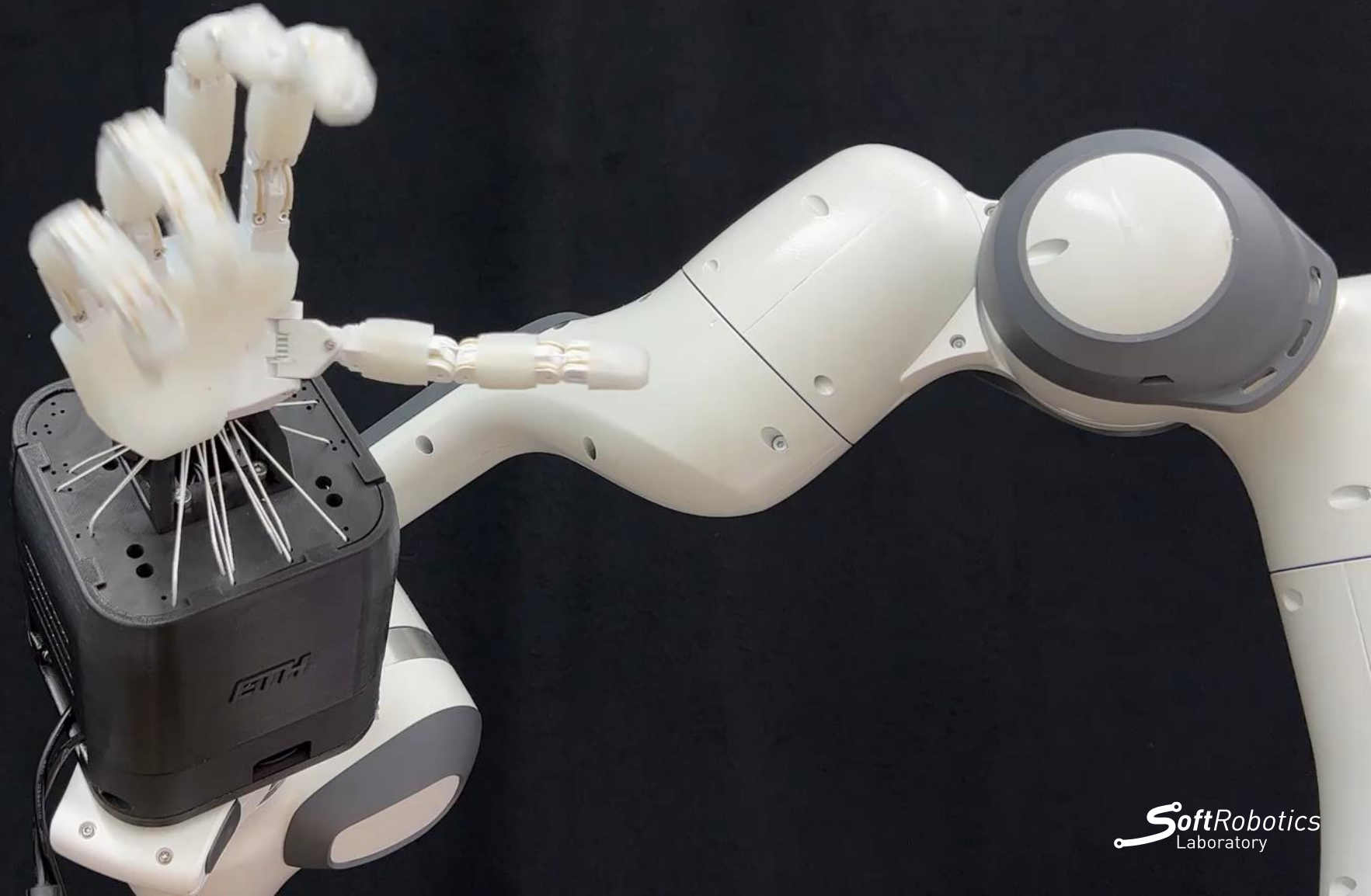
Versatile



Complicated

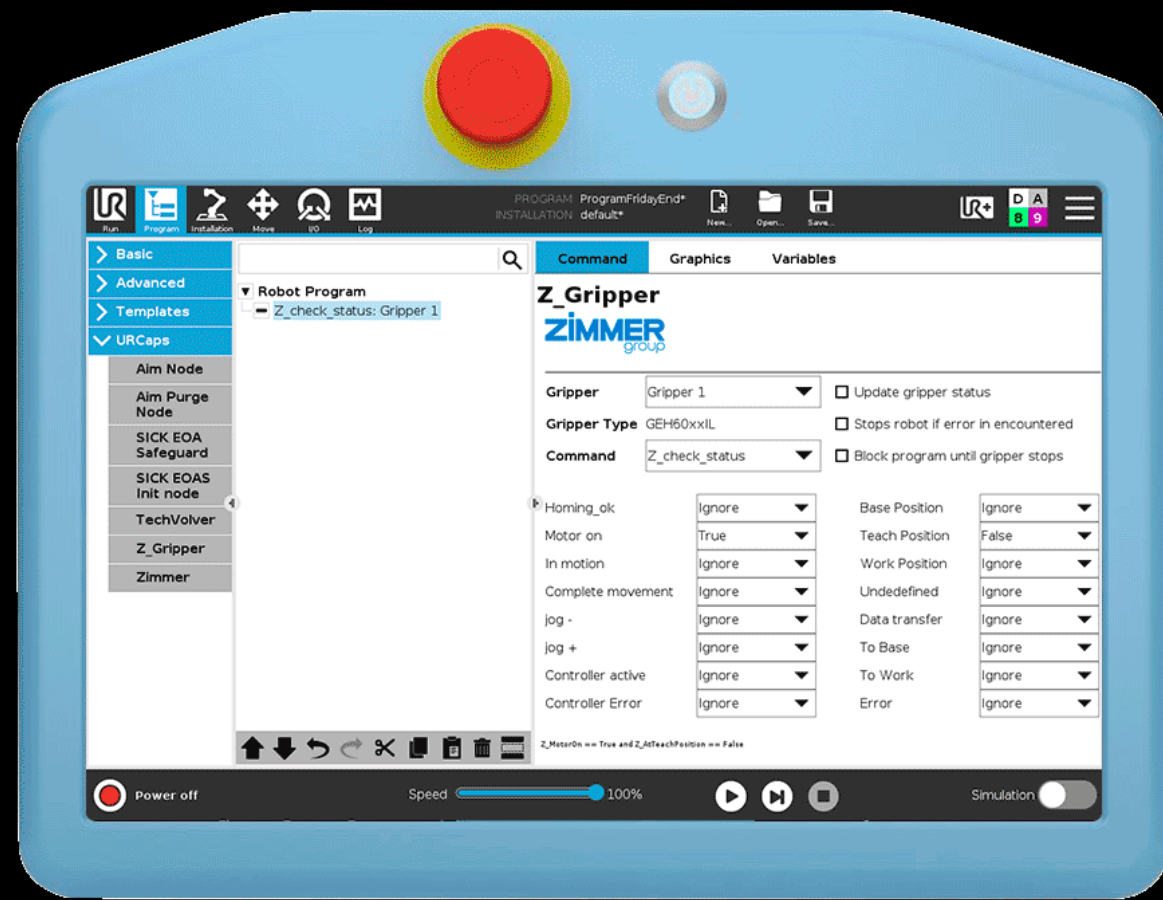


**Automate complex tasks with a versatile robotic platform driven by a dexterous hand and machine learning**

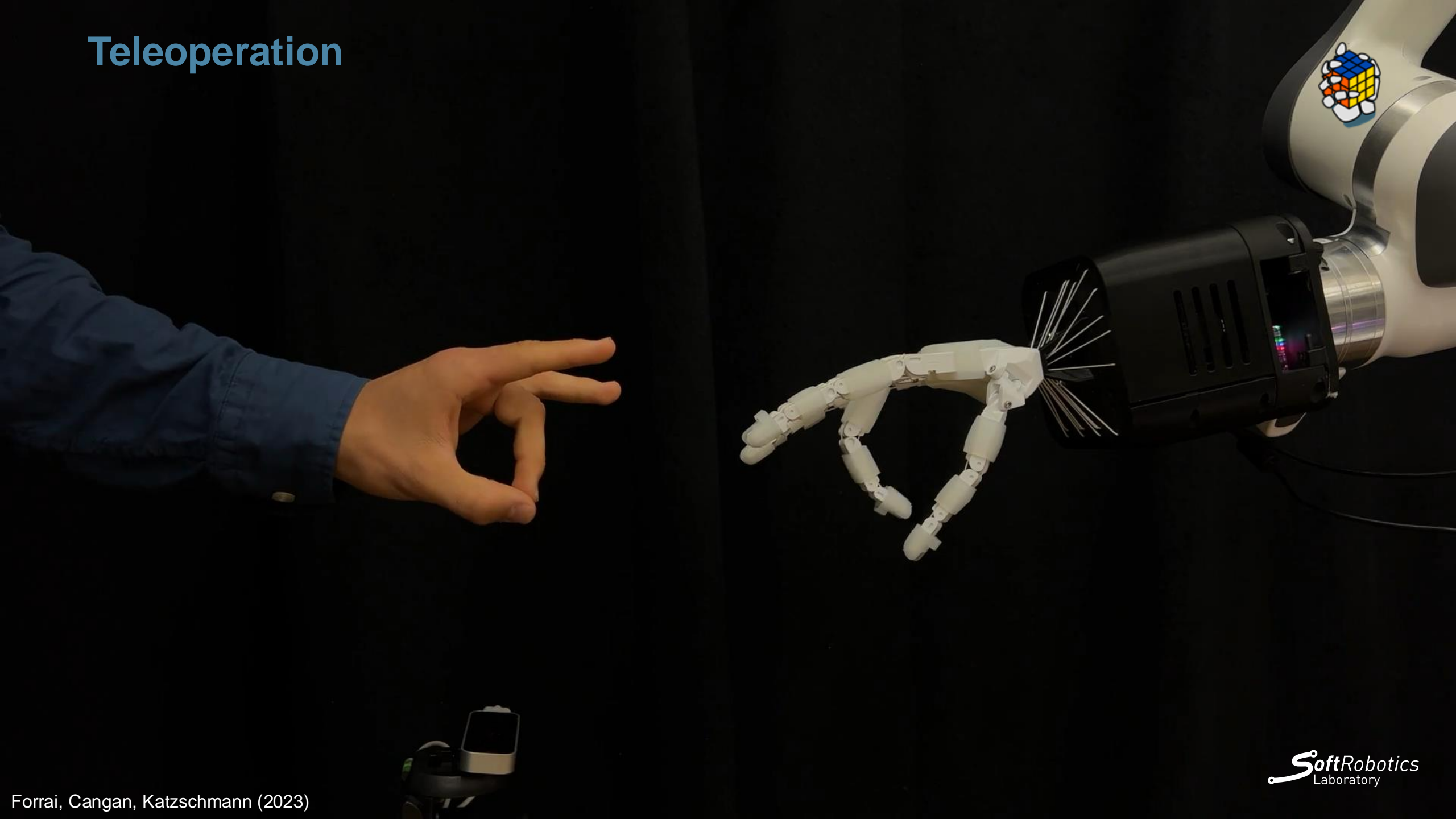


# Problem

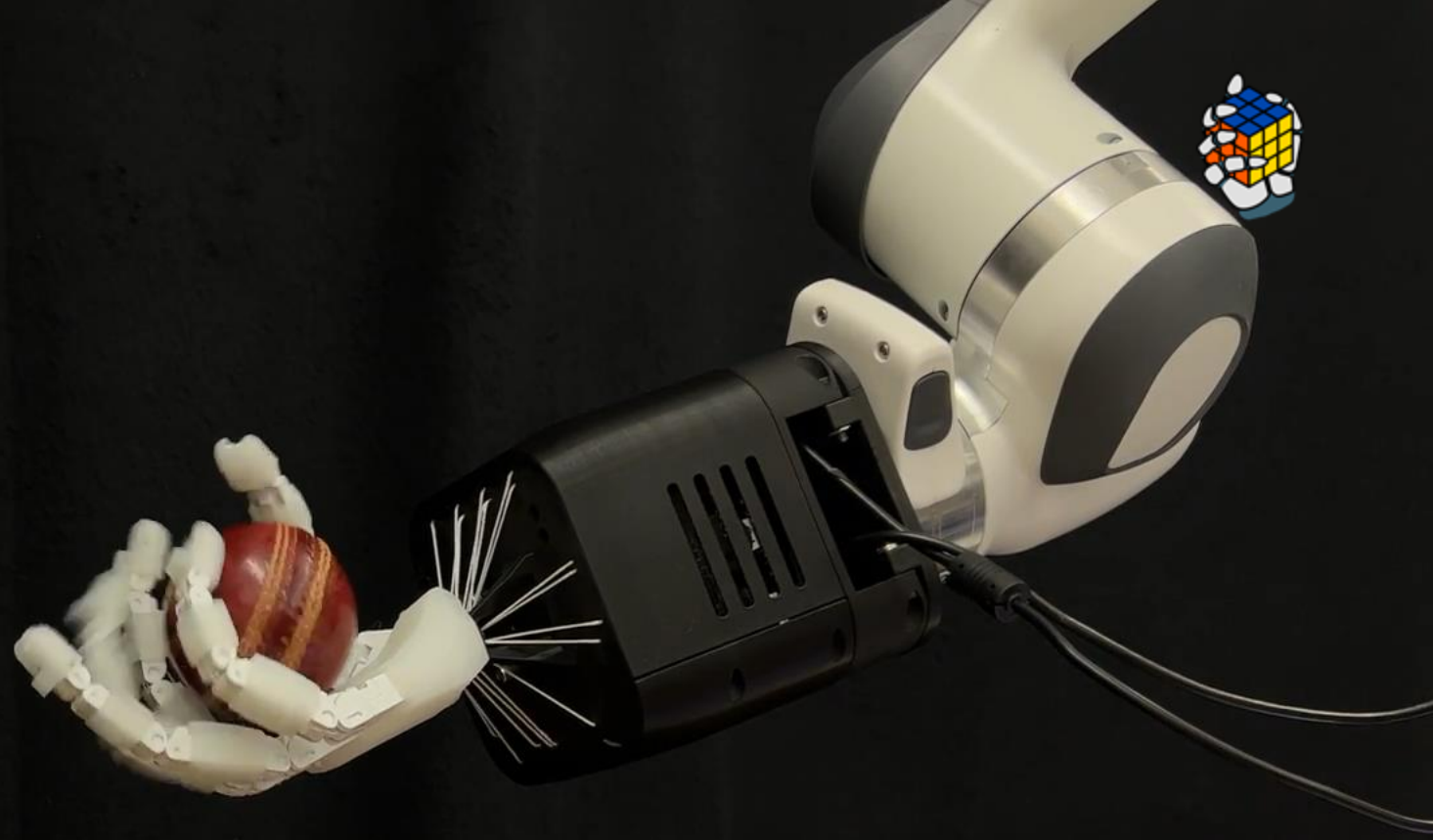
## Typically High Set-Up and Programming Effort

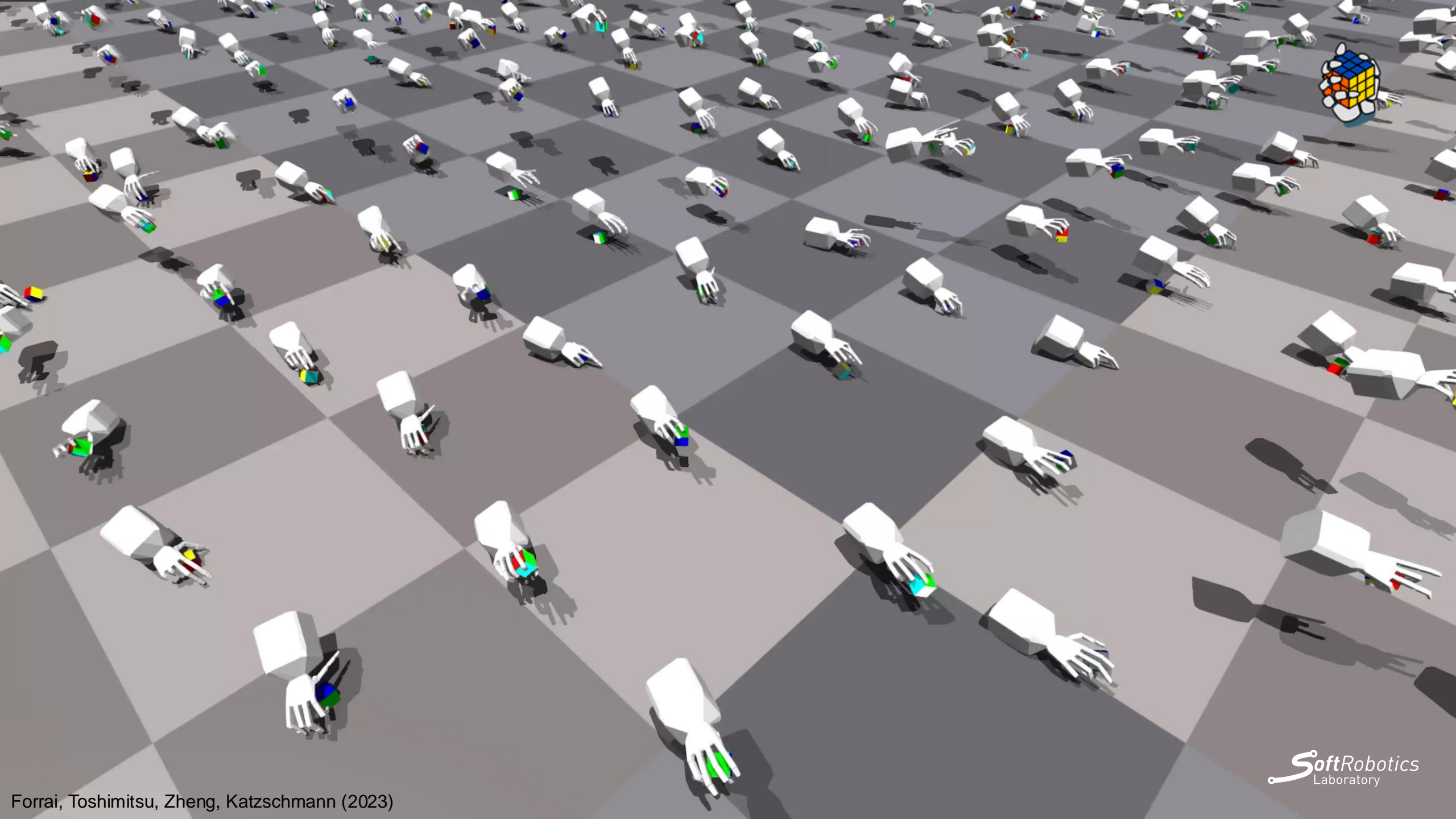


# Teleoperation



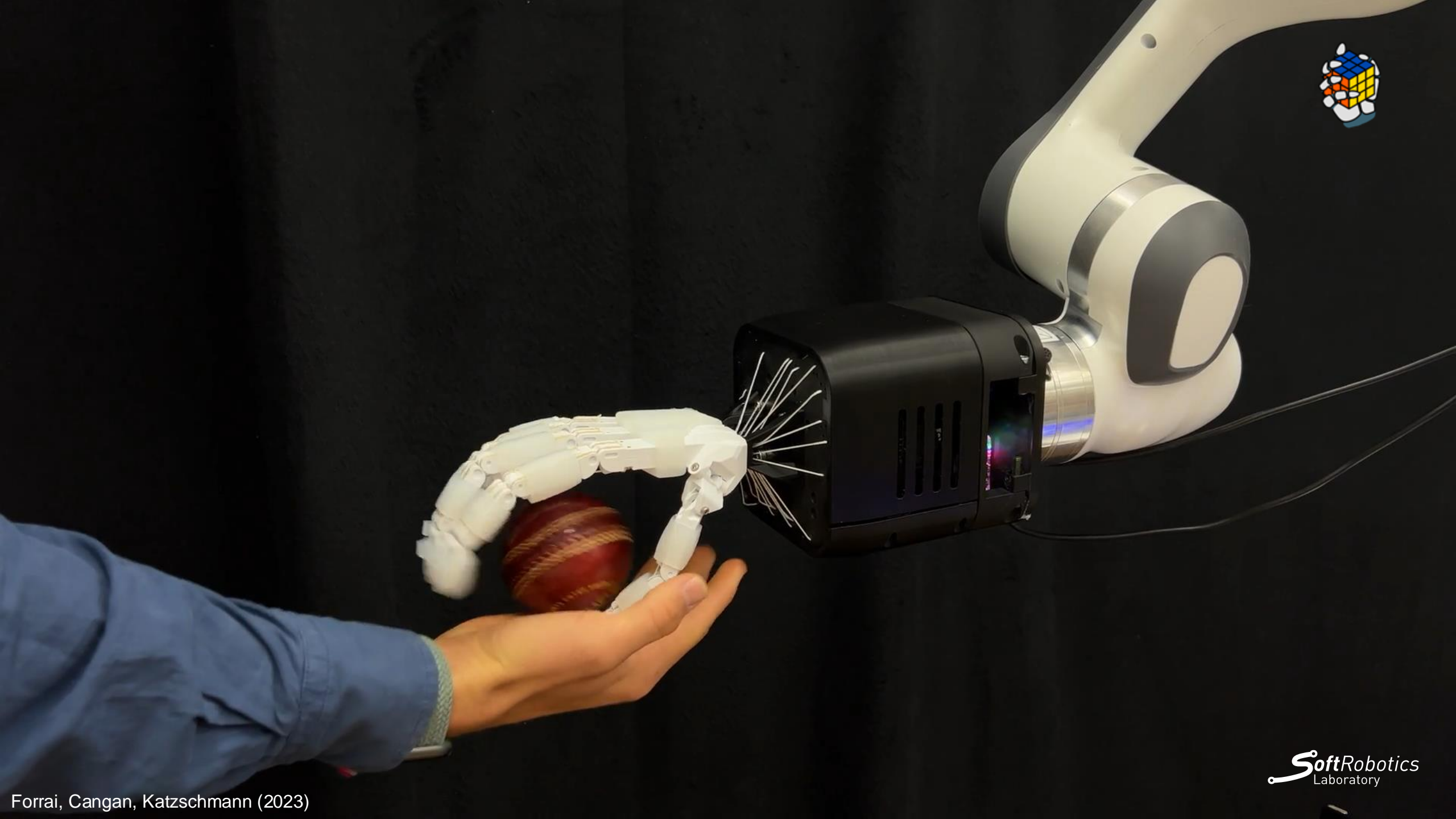
# Autonomous rolling

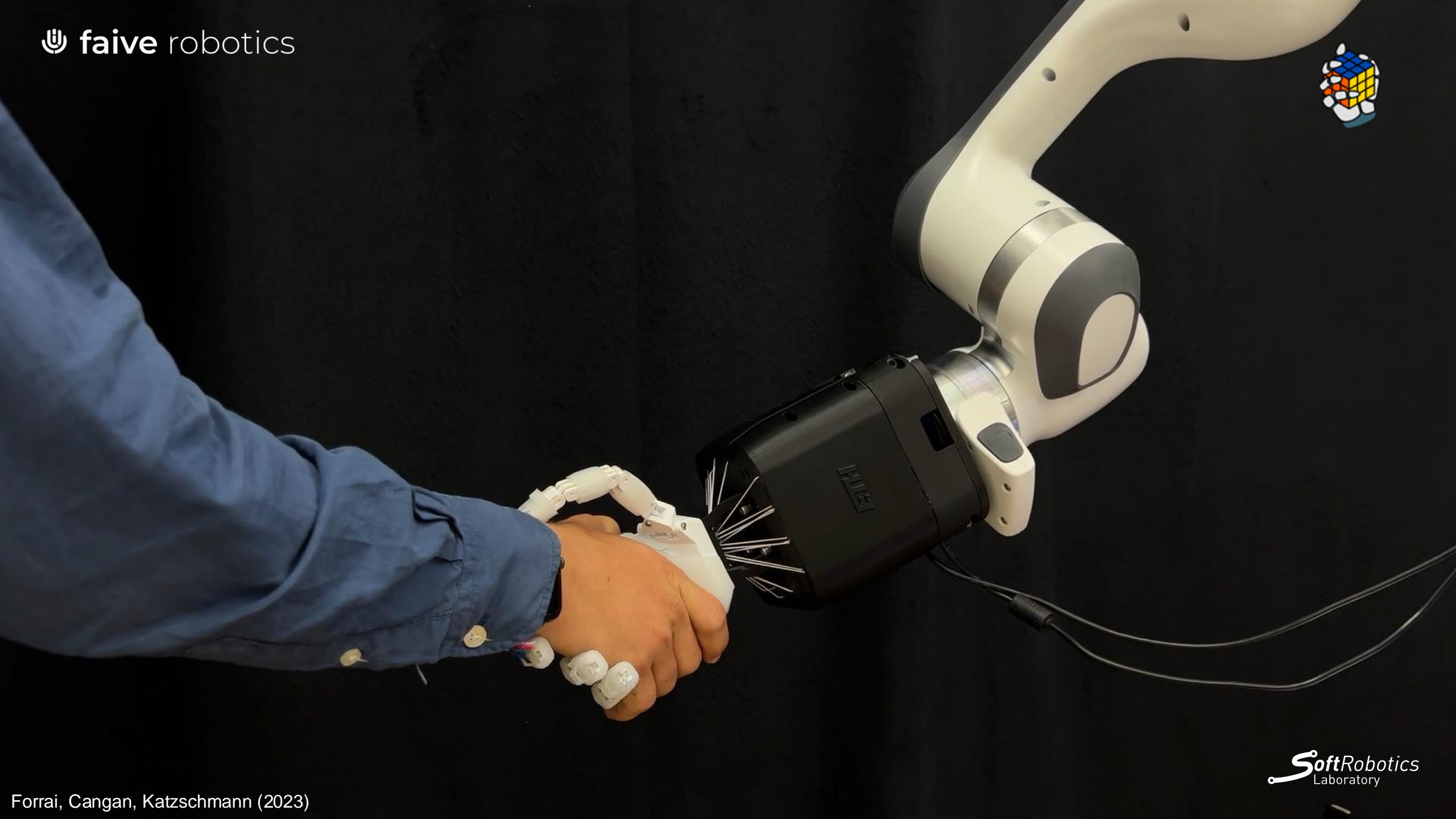












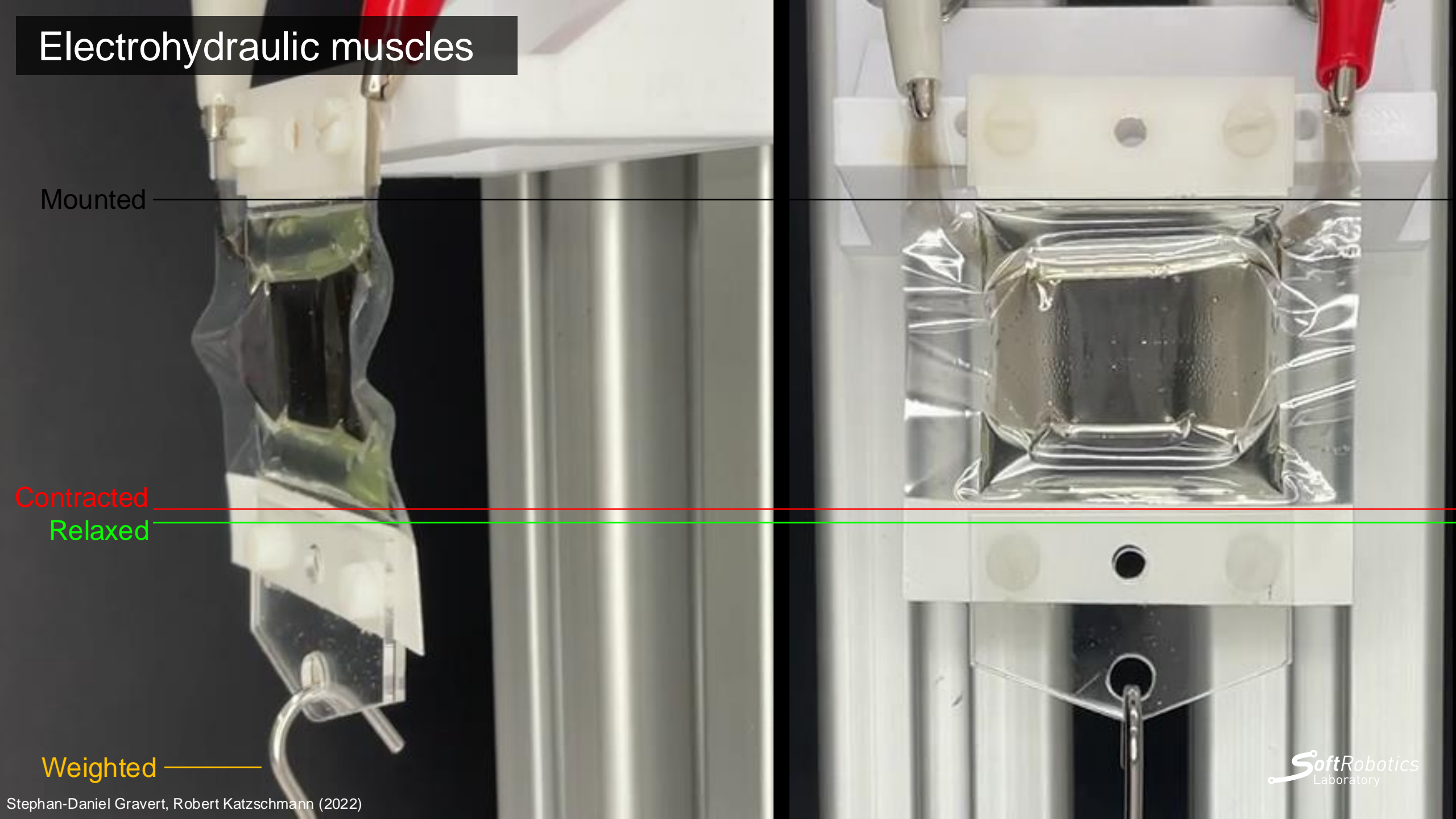
Beyond this class

# Electrohydraulic muscles

Mounted

Contracted  
Relaxed

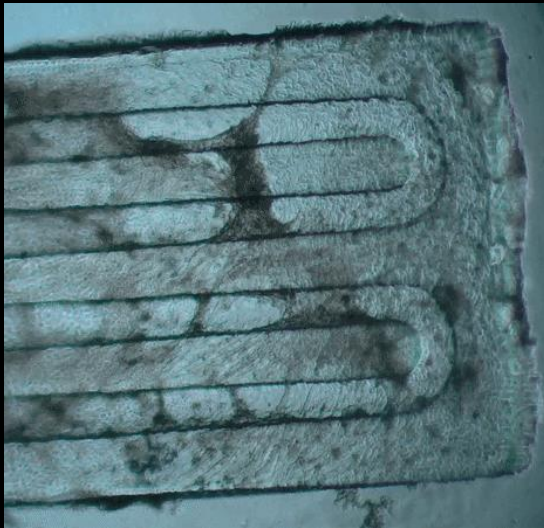
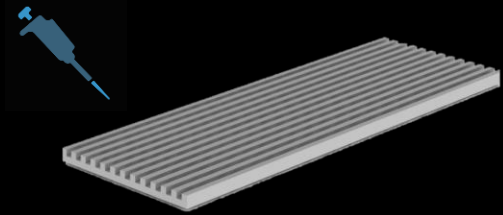
Weighted





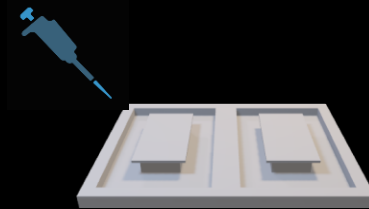
# Biohybrid Muscles

Thin films: topographical cues

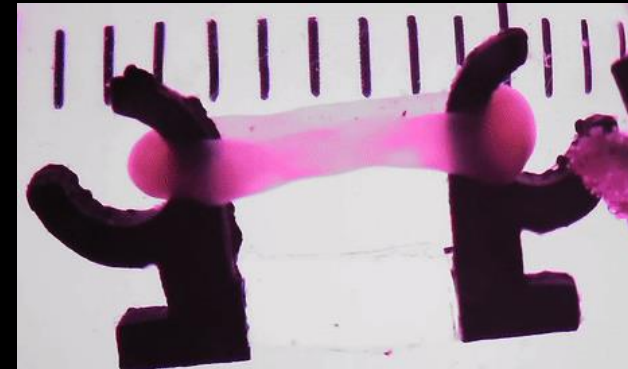
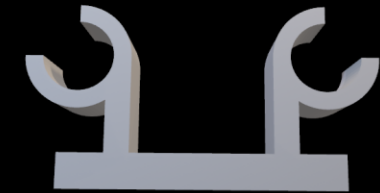


Dr. Öncay Yasa, SRL ETHZ

3D ring: mechanical & electrical stimulation during differentiation

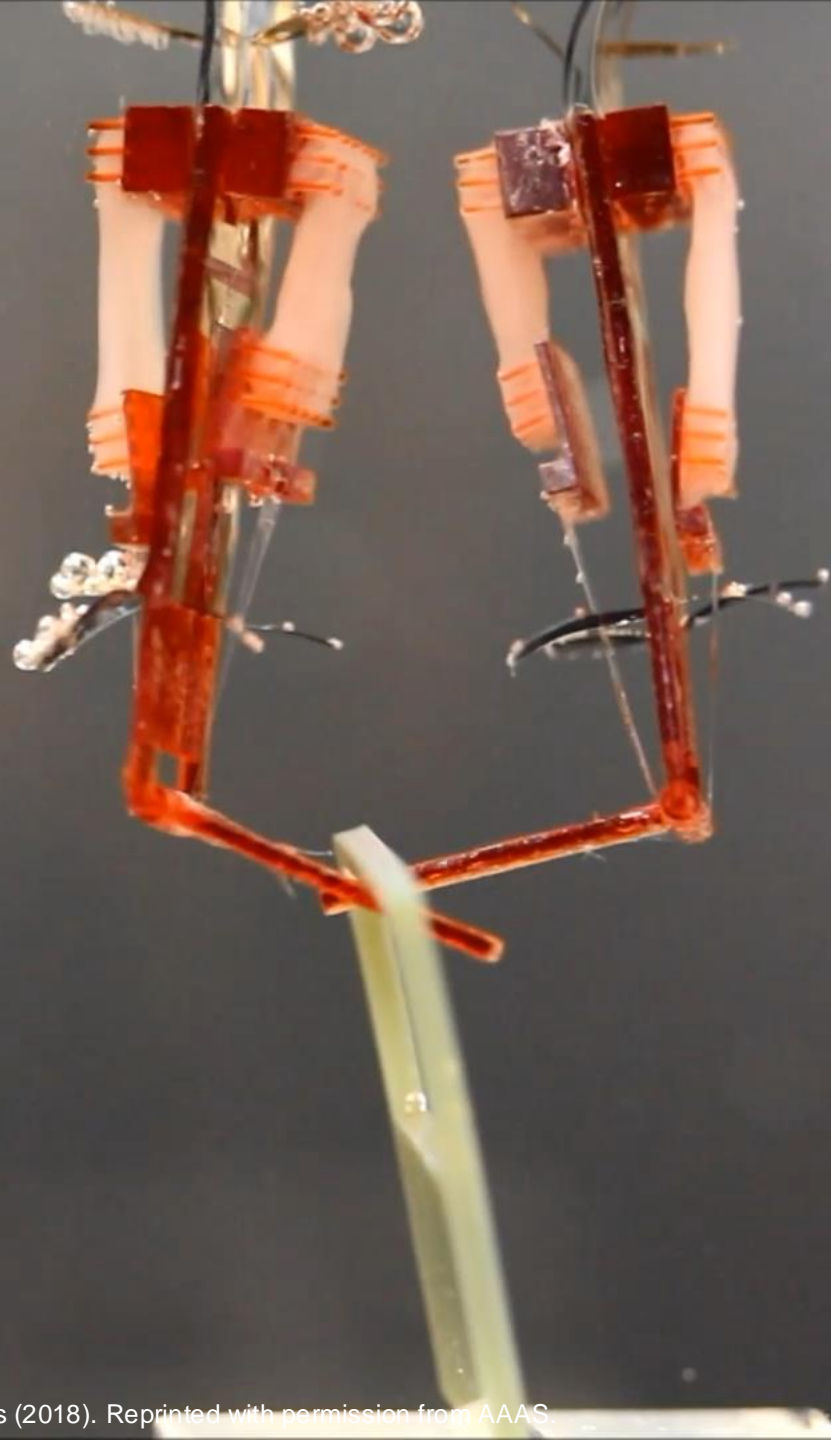


Transfer



Aiste Balciunaite, SRL ETHZ

# Biohybrid Robot



# Outlook





# Teaching Team



**Prof. Dr. Katzschmann**  
*Lead Organizer*



**Robert Jomar Malate**  
*Lead Teaching Assistant*



**Ronan Hinchet**  
*Sr. Scientist & Post Doc @  
SRL*



**Gavin Cangan**  
*PhD @ SRL*



**Thomas Buchner**  
*PhD @ SRL*



**Chenyu Yang**  
*PhD @ SRL*



**Davide Liconti**  
*PhD @ SRL*



**Yasunori Toshimitsu**  
*PhD @ SRL*

**Dr. Anhui Wu**  
*Lab Technician  
+ Manager*



**Dr. Miriam Filippi**  
*Perfusable  
Large-scale Muscles*



**Lewis Jones**  
*Volumetrically Printed  
Cardiac Muscles*



**Aiste Balciunaite**  
*Untethered Biohybrid  
Muscle Actuators*



**Manuel Mekkattu**  
*Modeling Biohybrid  
Muscles*



**Asia Badolato**  
*Neurotised Biohybrid  
Muscles*



**Dr. Ronan Hinchet**  
*Electrostatic Actuators  
and Soft Robots*



**Thomas Buchner**  
*Printed Robots +  
Electrohydraulic Legs*



**Deniz Albayrak**  
*Electric Muscles for  
Robots*



**Amirhossein Kazemipour**  
*Autonomous  
Musculoskeletal Robots*



**Gavin Cangan**  
*Proprioceptive Robotic  
Manipulation*



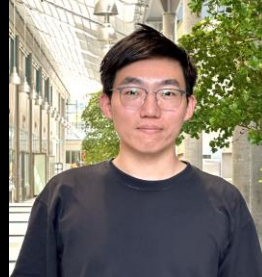
**Davide Liconti**  
*Learning-Based Control +  
Design for Manipulation*



**Federica Poltronieri**  
*Lab Admin  
+ Organizer*



**Chenyu Yang**  
*Learning Representation  
for Musculoskeletal Robots*



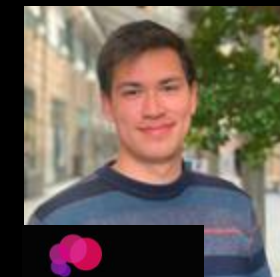
**Yasunori Toshimitsu**  
*Co-optimized  
Robotic Hands*



**Hehui Zheng**  
*Soft Robotic  
Reconstruction*



**Mike Michelis**  
*Learned Multiphysical  
Surrogates*



**Elvis Nava**  
*Dexterous Robotic  
Transformers*



Electrohydraulic Musculoskeletal Robots



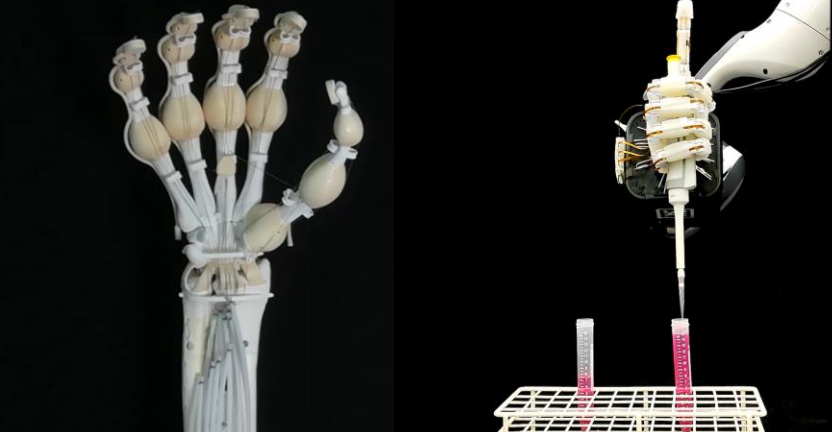
Bioinspired Locomotion for eDNA Sampling



Parallelized Manipulation Learning



Dexterous Robotic Manipulation



Low Voltage Electrohydraulic Muscles



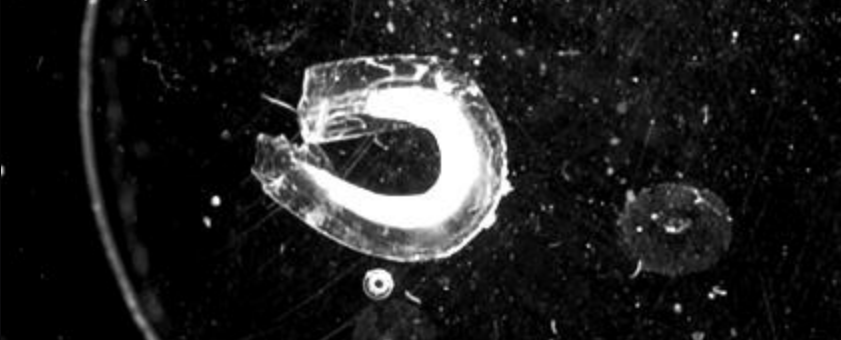
Soft Aerial Manipulation



Vision Controlled Jetting for Robots



Fast Biohybrid Swimmers



Dynamic Soft Manipulators

