

ROMANDIC winter school 2026

Kranjska Gora, Slovenia, Feb. 10th 2026

Attendees' pitch presentations Thursday



ROMANDIC

Robot Manipulation of Deformables through
Dynamic Actions

3 mins per presenter!

0 **Michal Radin-Rutkowski**

1	Berk	Güler
2	Branimir	Ćaran
3	Charlotte	Marquardt
4	Davide	Matteri
5	Filippo	Brasina
6	Francesco	Buso
7	Igor	Babić
8	Jay	Kamat
9	Mathilde	Kappel
10	Niklas	Arlt
11	O. Leon	Barbed
12	Oskars	Vismanis
13	Peter	Nimac
14	Petr	Vanc
15	Raman	Talwar
16	Samuele	Dell'Oca
17	Thomas	Haspl

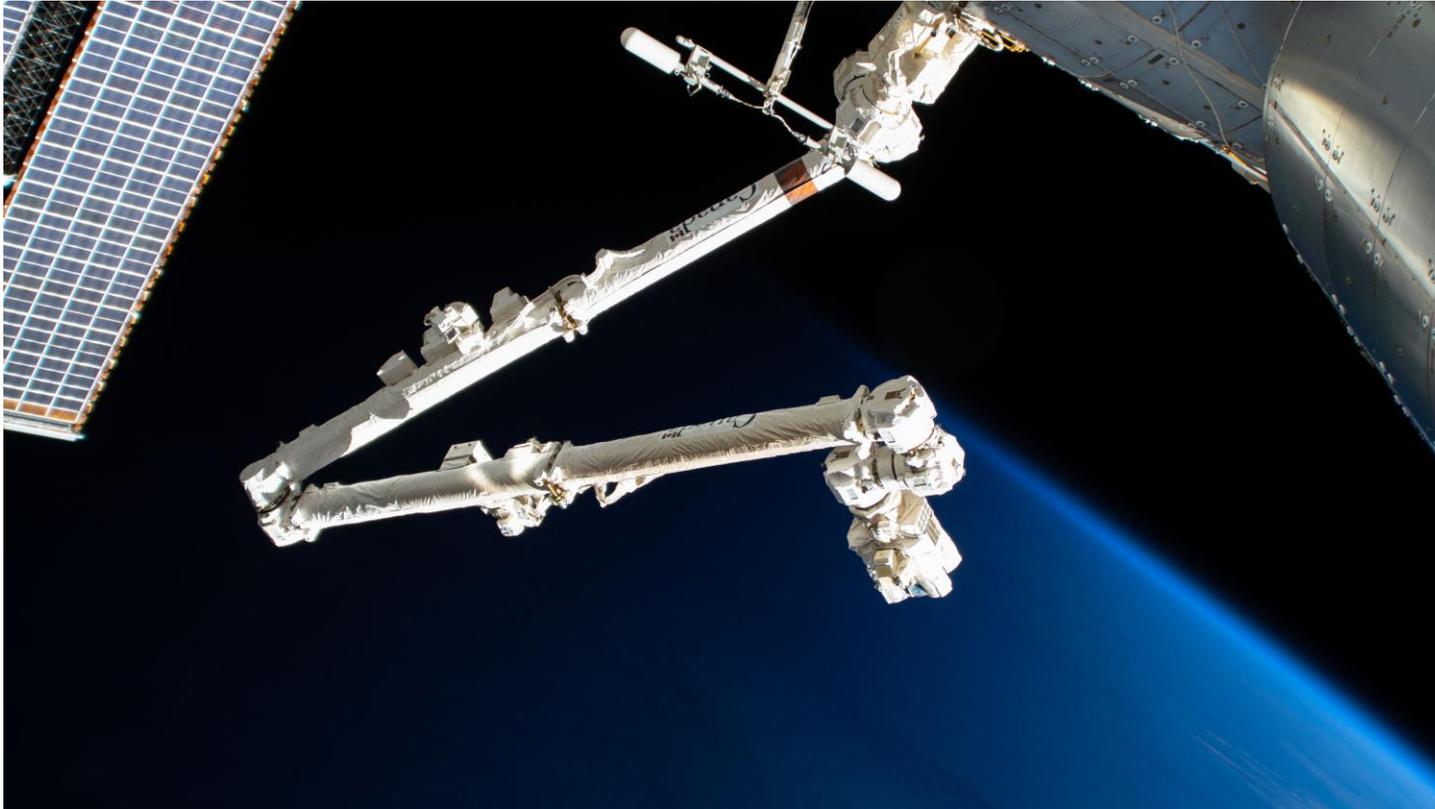
Michał Radin-Rutkowski

On-Orbit Robotic Disassembly

MICHAEL (MICHAŁ) STANISŁAW RADIN-RUTKOWSKI

DURHAM UNIVERSITY





European Space Agency (ESA). *Canadarm2 robotic arm*. 6 April 2020. ESA Multimedia Gallery. Image credit: NASA (ESA Standard Licence).

Introduction

On-Orbit Manipulation

- Capture, Handling, Servicing, Assembly, Disassembly

Motivation

- Servicing of existing space infrastructure
- Improving space exploration and exploitation capabilities
- Sustainable space operation practices

Challenges

Illumination

- Harsh, direct
- Dynamic

On-Orbit Manipulation

- Microgravity
- Dynamic coupling
- Vibrations

Disassembly

- Target orientation, condition, configuration

Simulation and Ground Verification

Software

- ROS 2
- MuJoCo
- ROS-MuJoCo Bridge

Two xArm6 manipulators

- Hardware in the loop system



UFACTORY xArm 6 robotic arm. UFACTORY USA product page. <https://www.ufactory.us/product/ufactory-xarm-6>.

Satellite Mock-up

Satellite side panel

- Multilayer Insulation (MLI) covered frame
- Various satellite components

Recreation of the orbital lighting conditions

Use in further research

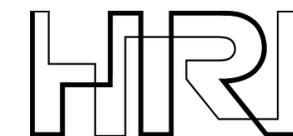
- Initially focusing on perception challenges
- Screw detection and improvement of perceptibility
- Later to be used for manipulation tasks

Thank you for your attention

Berk Güler



TECHNISCHE
UNIVERSITÄT
DARMSTADT



Honda Research Institute EU



Toward Reliable Assistive Teleoperation for Deformable Linear Object Manipulation

Berk Güler

ROMANDIC WINTER SCHOOL, February 2026





PhD Student in Computer Science
TU Darmstadt, Germany

2023 - Present

Supervisors: Prof. Dr. Jan Peters (Intelligent Autonomous Systems [IAS])
Dr. Simon Manschitz (Honda Research Institute EU)

M.Sc. in Mechanical Engineering
Koc University, Türkiye

2020 - 2023

Supervisor: Prof. Dr. Çağatay Başdoğan (Robotics and Mechatronics Laboratory [RML])

B.Sc. in Control and Automation Engineering
Istanbul Technical University, Türkiye

2015 - 2020

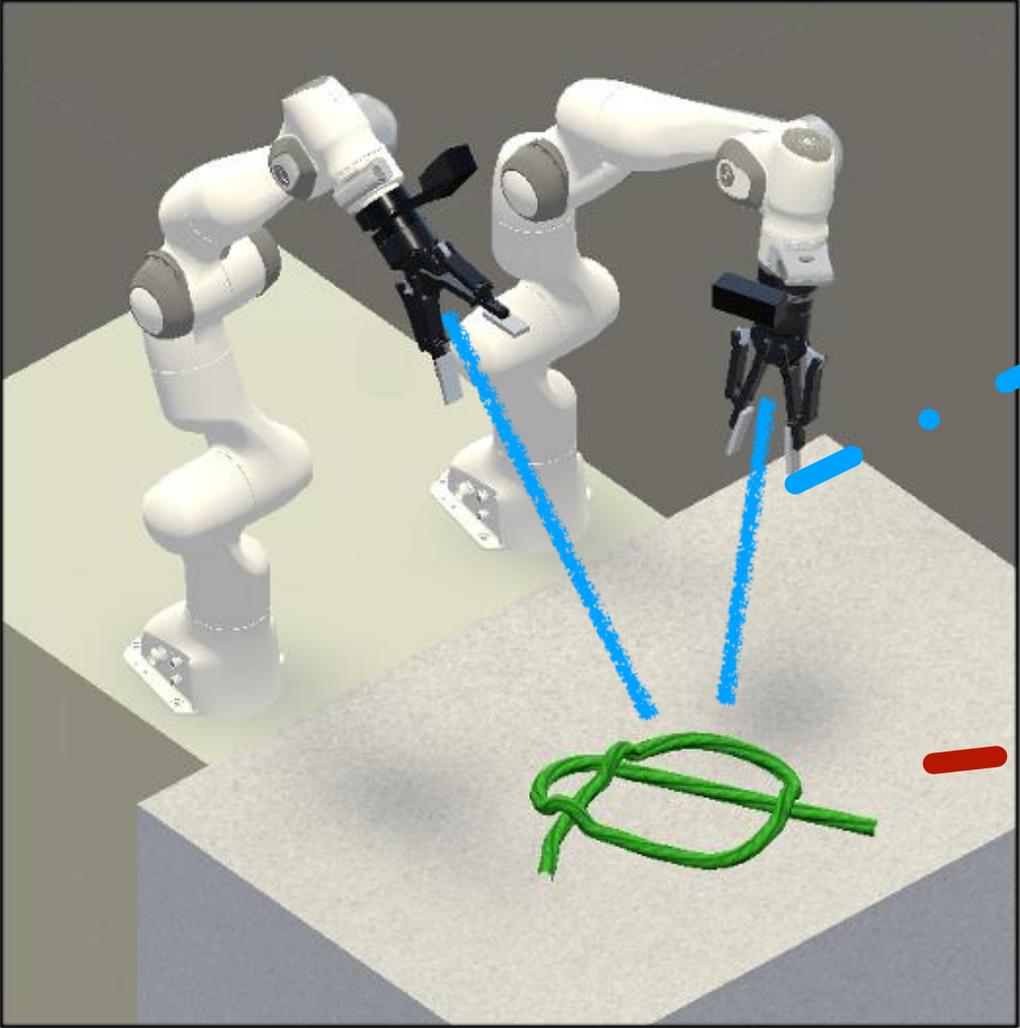


WHY DO WE NEED **TELEOPERATION** FOR MANIPULATION DEFORMABLE LINEAR OBJECTS (**DLOs**)?

- Sensitivity to motion
- Sensitivity to contact
- Poor and unstable state estimation
- Handling unpredictable behaviors
- Safety during human-robot interaction



MOTIVATION: DESIGNING AN ASSISTANCE FOR THE DLO MANIPULATION



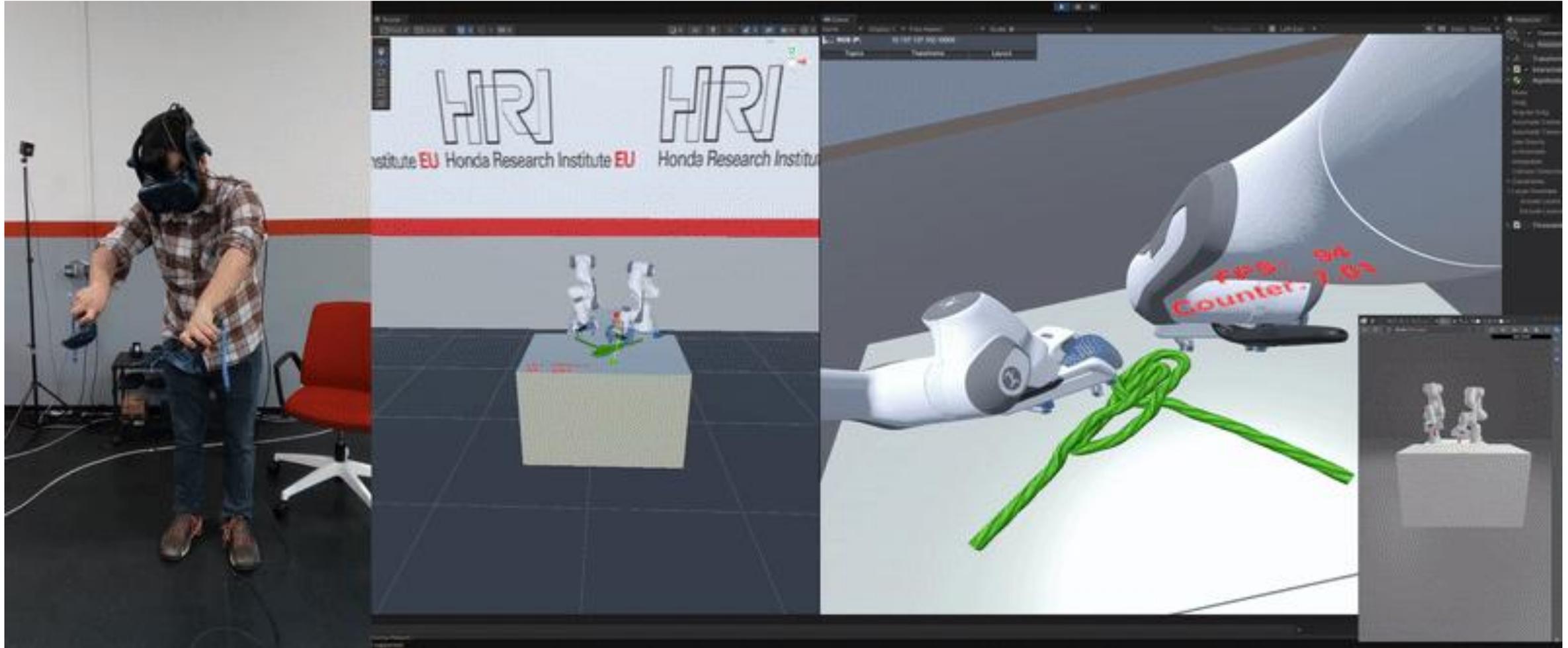
DLO Perception



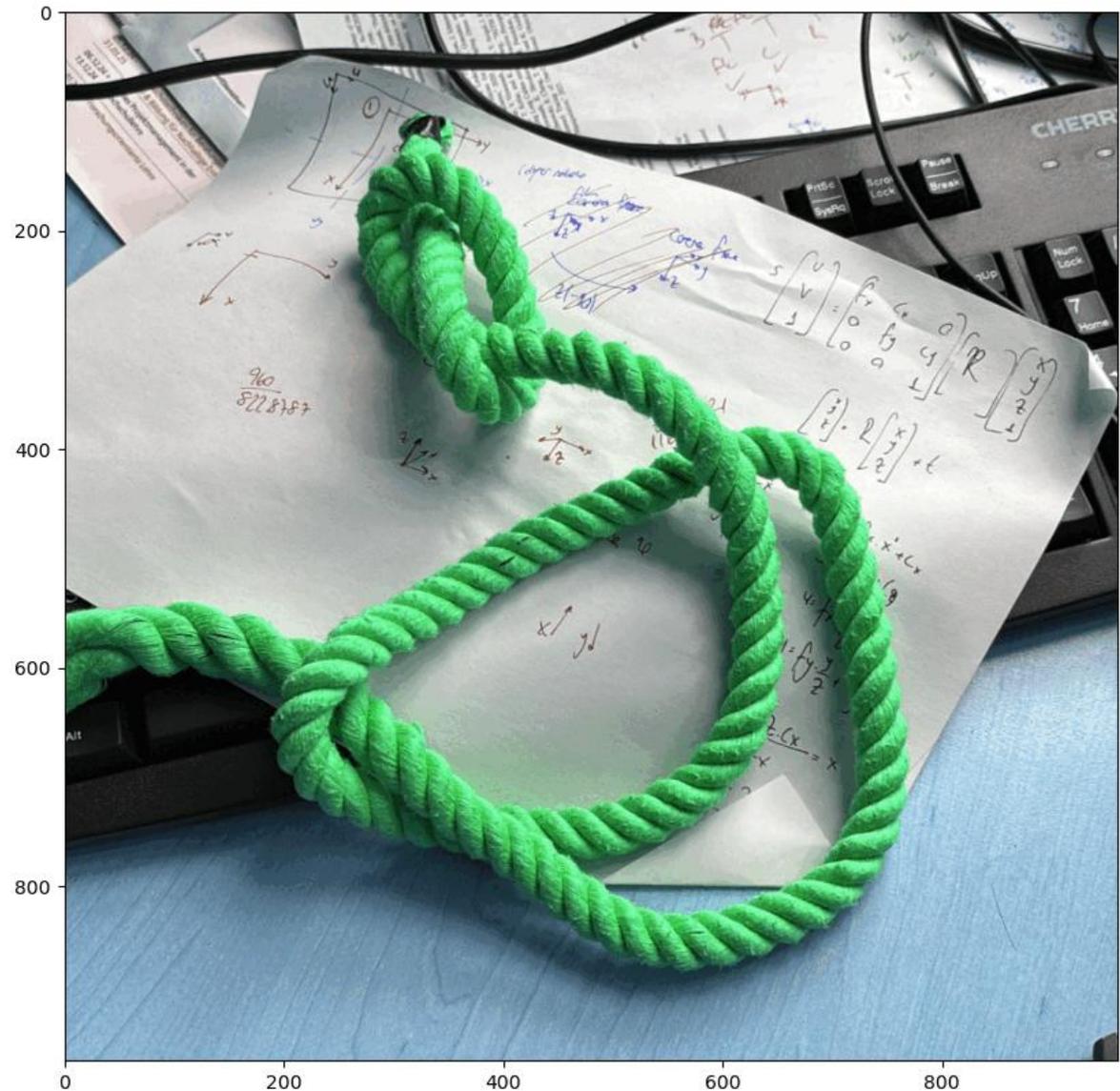
**Safety-Aware
Shared Autonomy**



Towards Assistive Teleoperation for Knot Untangling



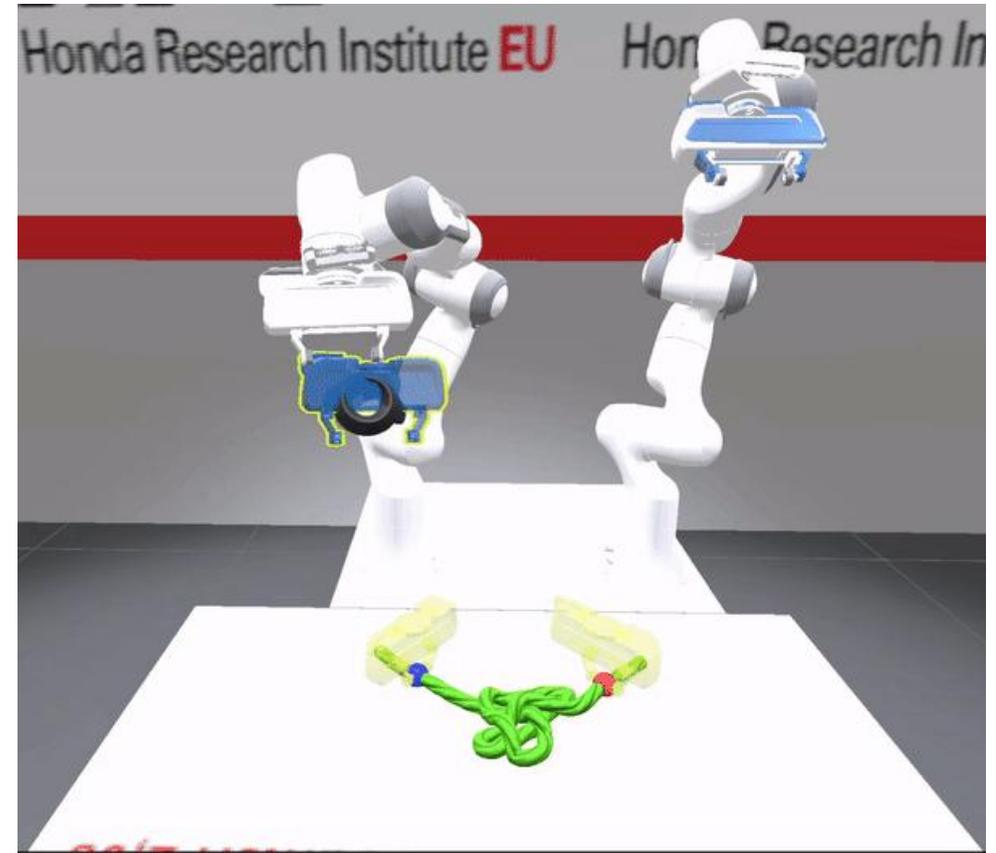
Rope State Estimation



Shared Autonomy

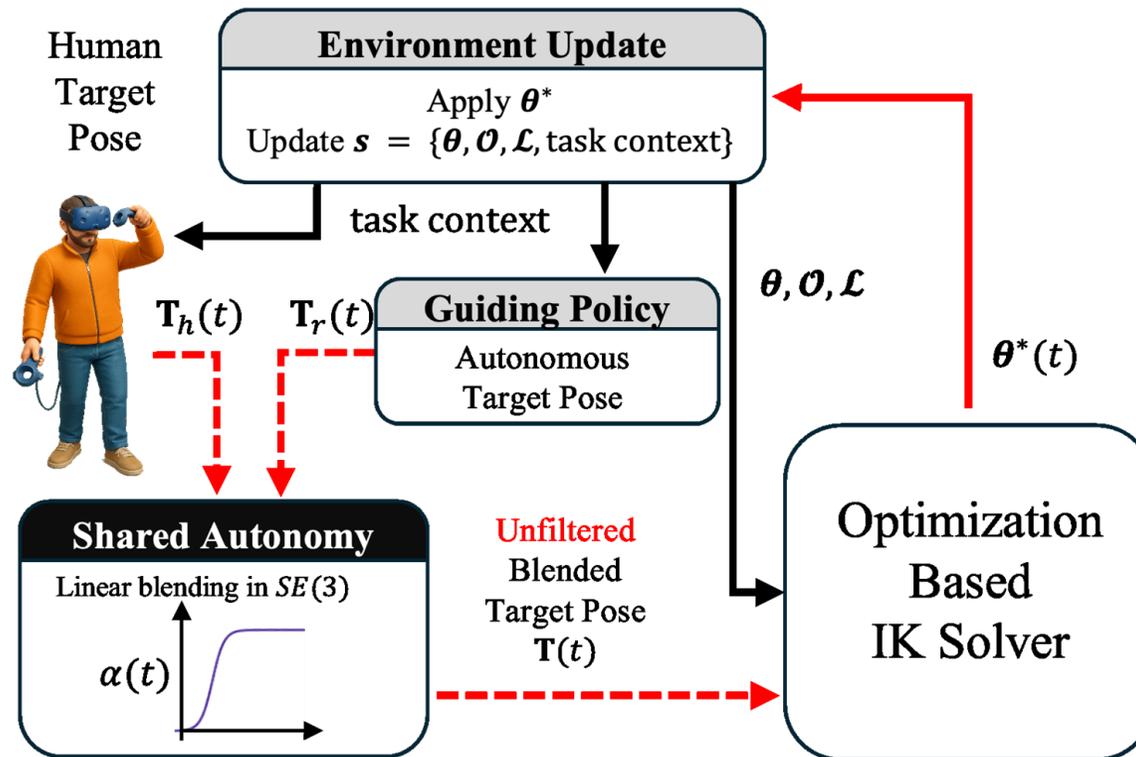


$$p_g = \alpha p_{human} + (1 - \alpha) p_{AI}$$



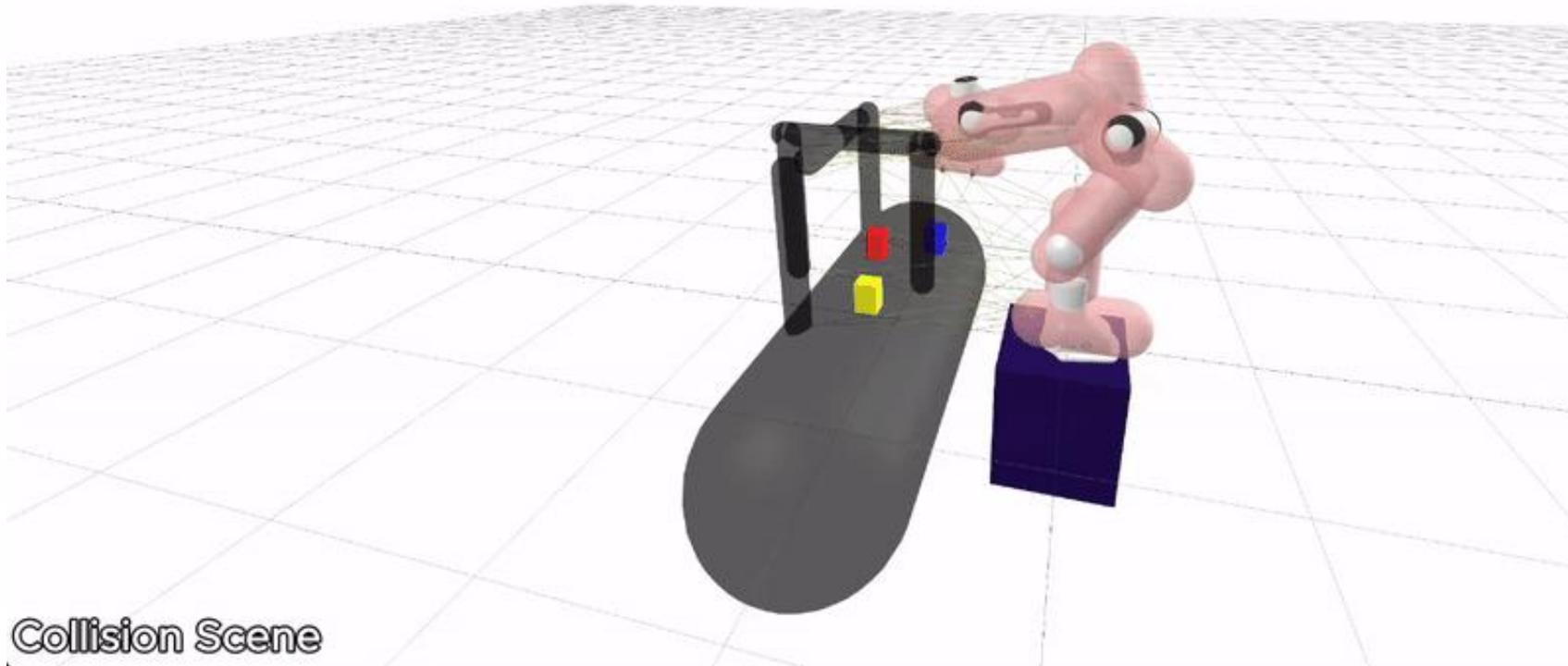
BarrierIK

Motivation: Arbitration between user and autonomous inputs can produce unsafe blended target poses in cluttered environments.



BarrierIK

We propose BarrierIK, a safety-filtered inverse kinematics solver that integrates Control Barrier Functions.



Safety-Aware Shared Autonomy



DLO Perception

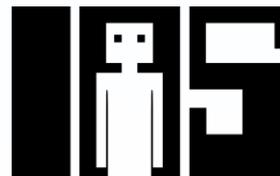


- More intuitive, and safe teleoperation frameworks

- More stable, and accurate DLO state estimators



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DARMSTADT



HIRI

Honda Research Institute EU

Branimir Ćaran



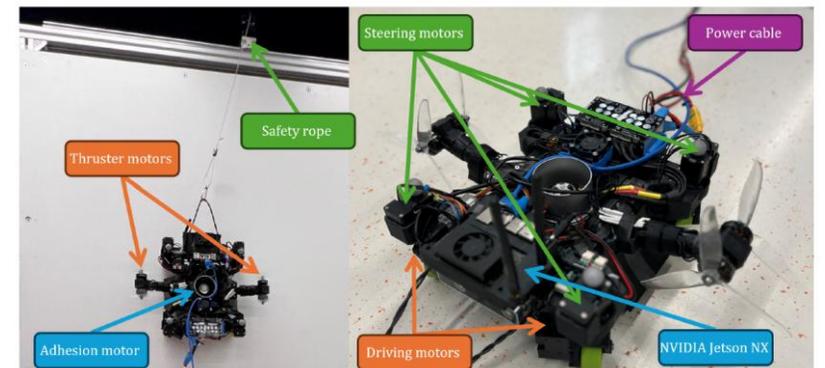
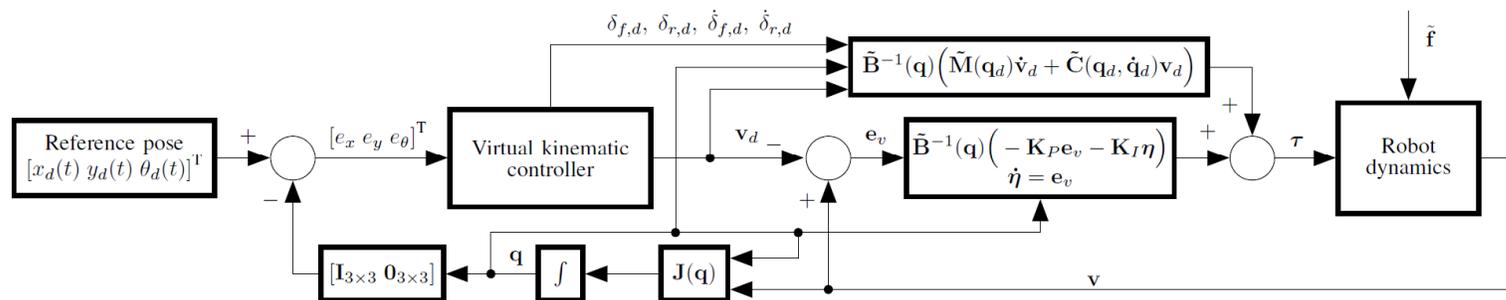
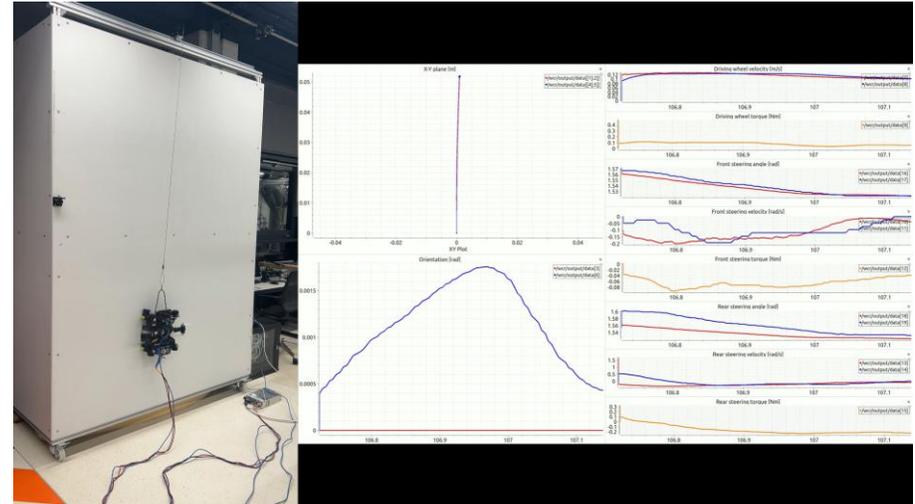
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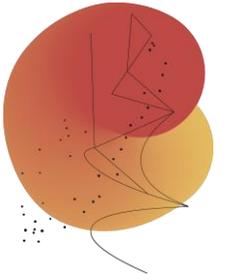


Pose estimation and motion control of a mobile robot on vertical surfaces.

PhD Thesis

- 4WIS4WID mobile robot
- Control of hybrid drone and mobile robot for vertical surfaces
- Pose estimation of mobile robot on vertical surfaces





Methodology - KO

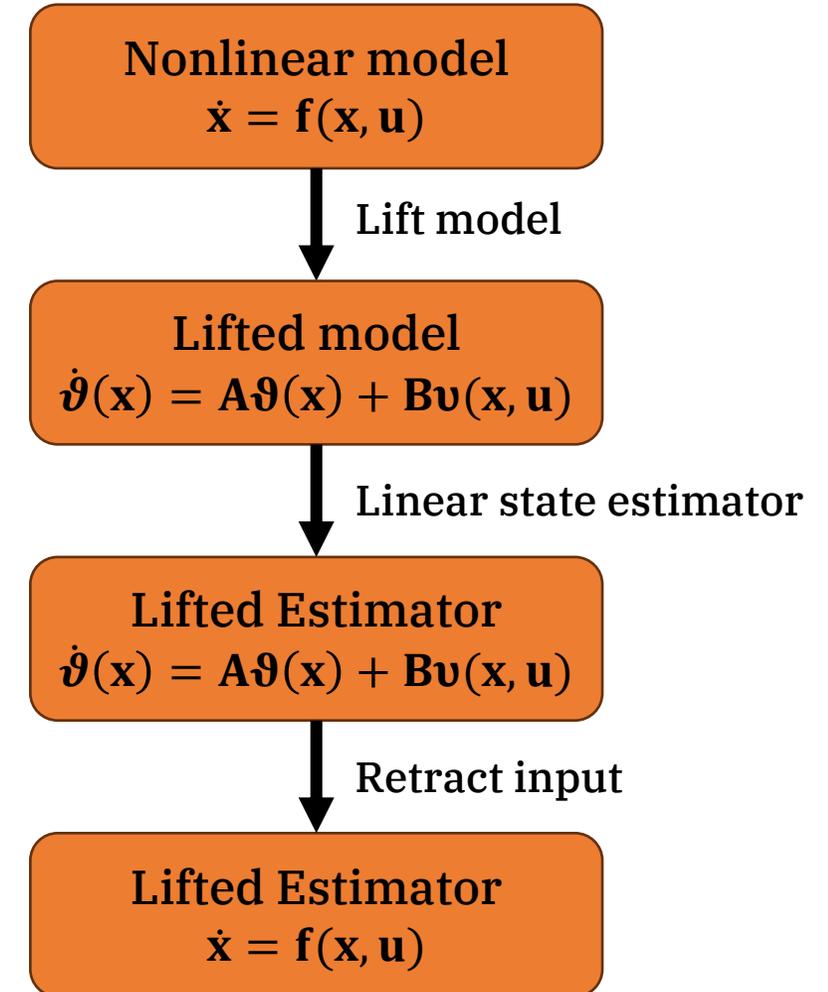
The Koopman Operator

- Using the Koopman operator, a **nonlinear system** can be globally represented by an **infinite-dimensional linear system**

Methodology:

- Lift state space into infinite-dimensional space
- Advance lifted state with the Koopman operator
- Design linear controller in lifted space
- Retract control input to get nonlinear controller

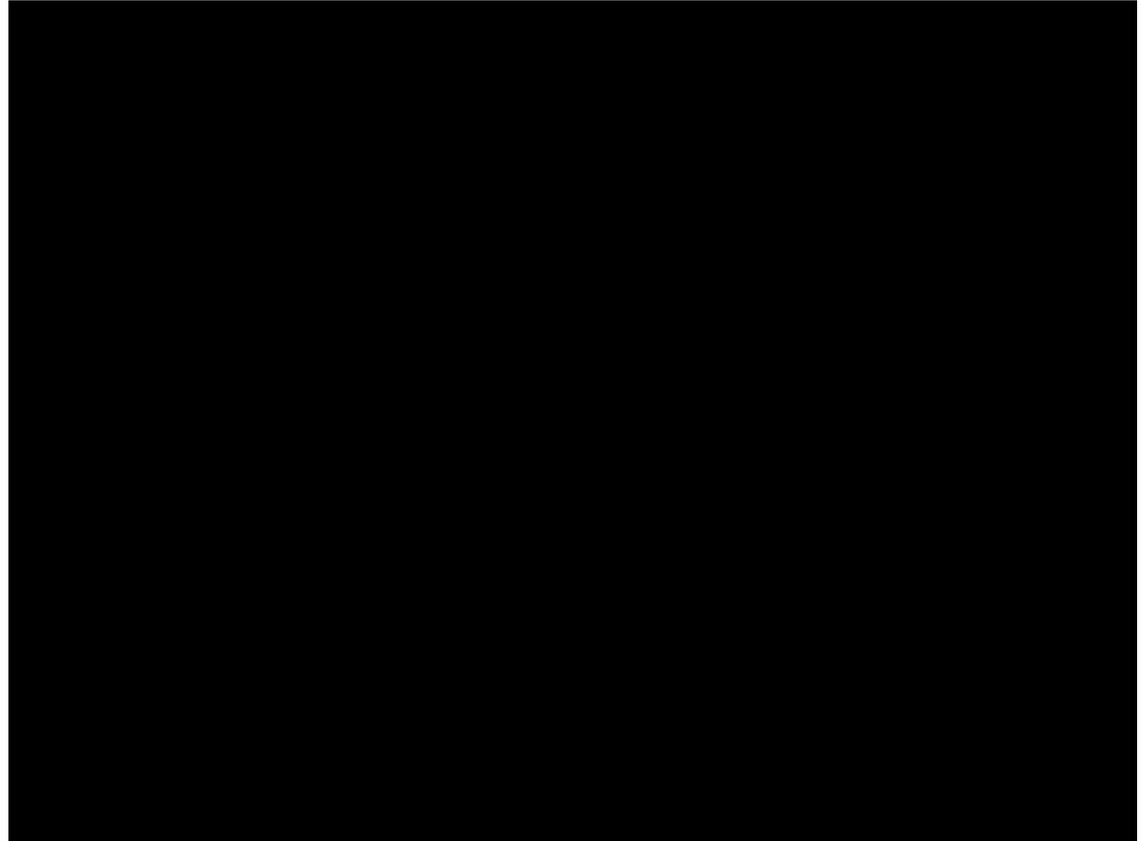
Use **data-driven methods** to approximate a **finite-dimensional Koopman operator**





ROBOCAMP

- **User Triggers the “Search” command**
 - The drone initializes the “Search Template” if the target person is known
 - When the target person is recognized, the drone centers person in the middle of camera frame.
- **User Triggers the “Follow” command**
 - The person is being tracked and followed using drone.

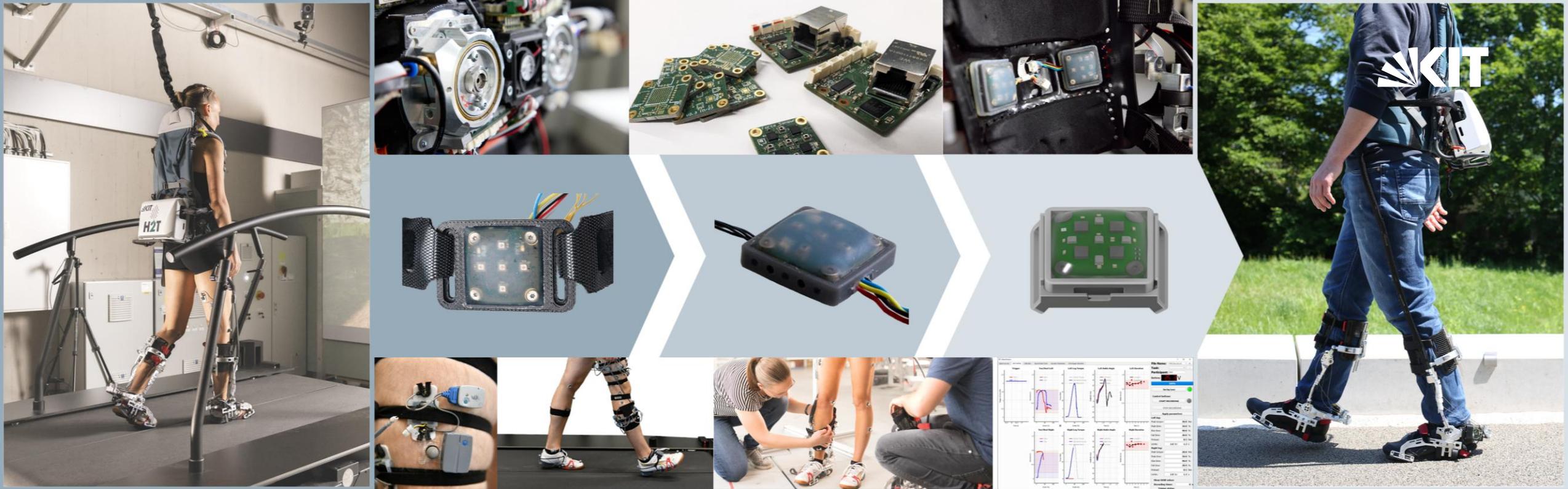




Thank you!

12.02.2026., Kranjska Gora | ROMANDI Winter School

Charlotte Marquardt



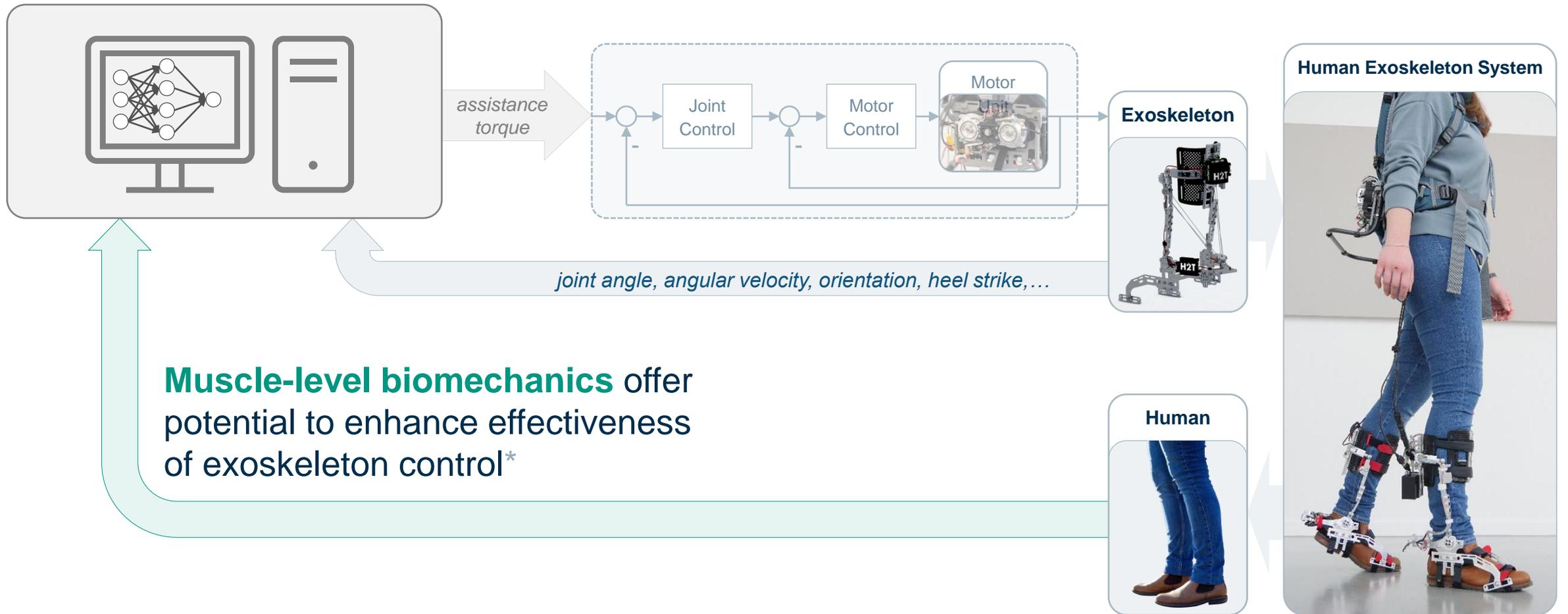
Force Myography for Exoskeleton Control

Charlotte Marquardt

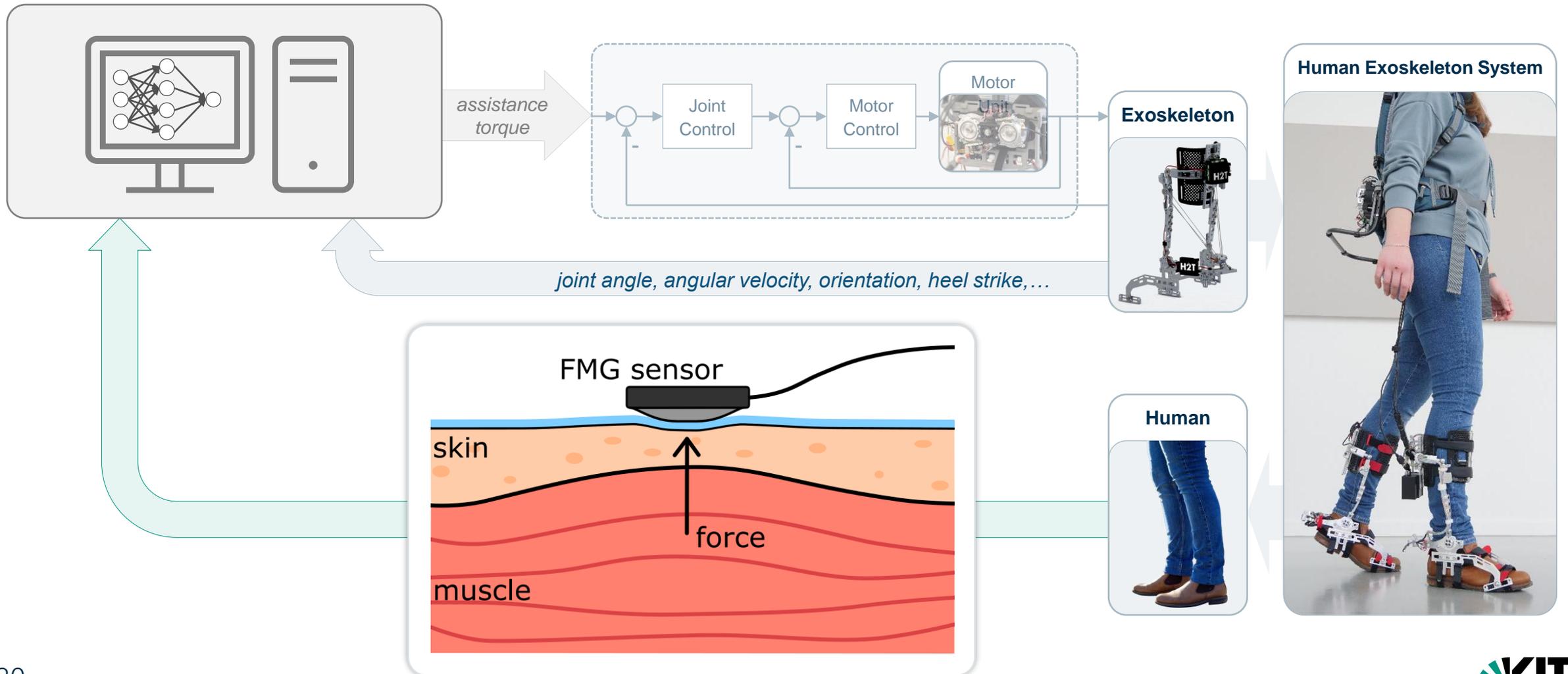
High Performance Humanoid Technologies Lab (H²T)
Institute of Anthropomatics and Robotics (IAR)
Karlsruhe Institute of Technology (KIT)

H²T
High Performance Humanoid Technologies

Motivation

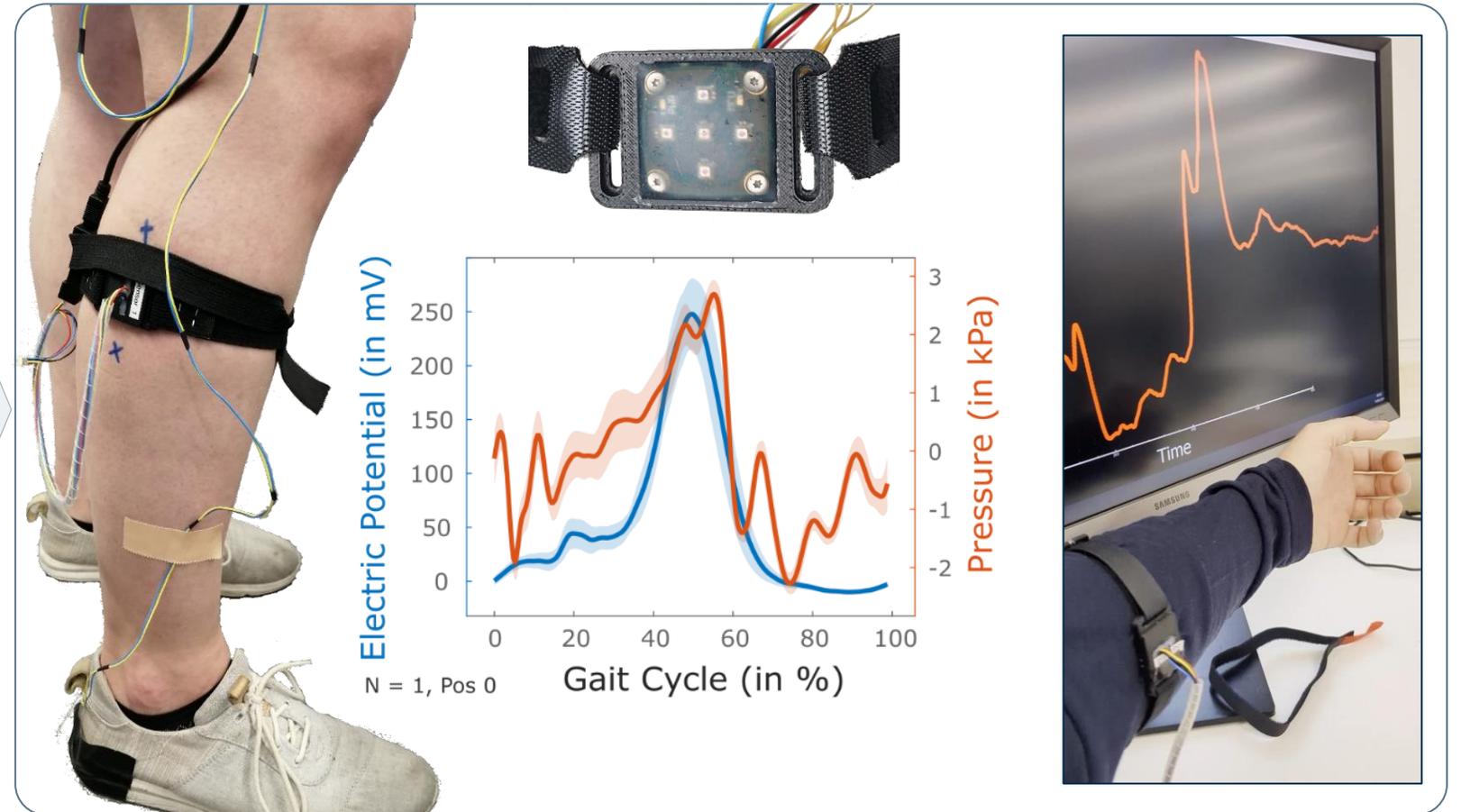
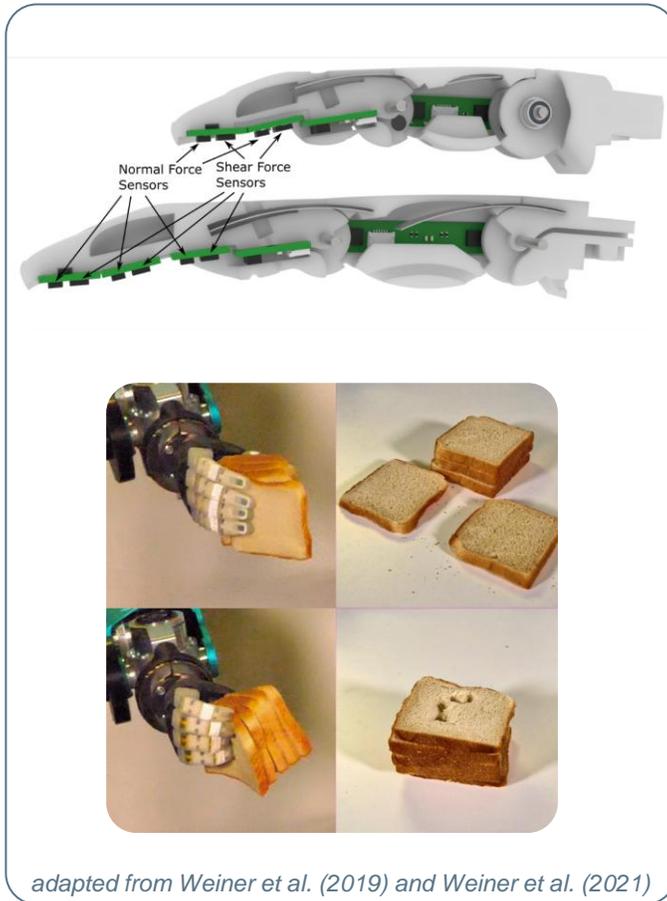


Motivation



FMG Sensor Unit

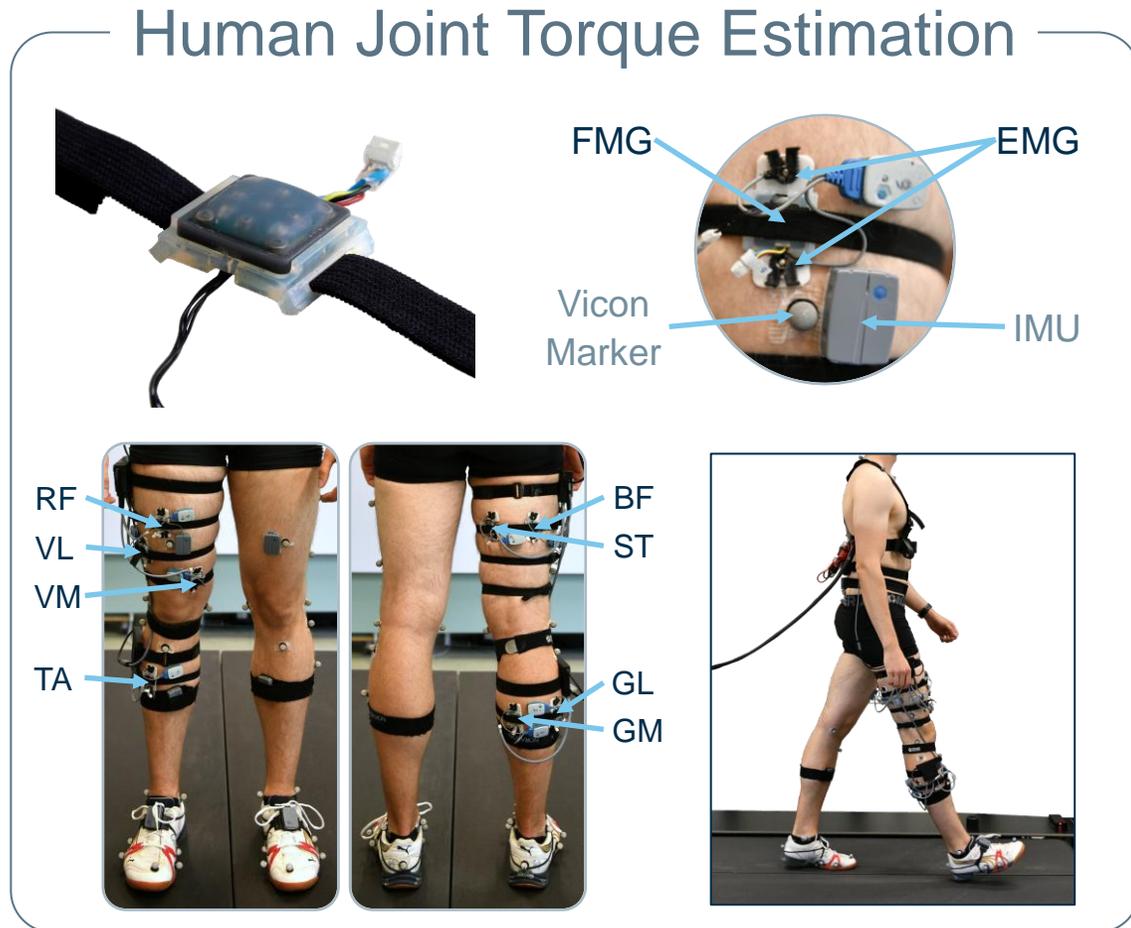
Design and Evaluation



FMG Sensor Unit

Application

Human Joint Torque Estimation



Exoskeleton Integration





Charlotte
Marquardt



Miha
Dežman



Tamim
Asfour

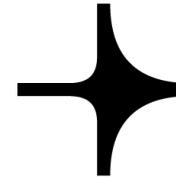
...and our students:

Tim Wolk, Arne Schulz, Julia Hohensee, Erik Schroeter, Tristan Zinnschlag, Kjell Marquardt, Marie Kautt, Alexander Wirner, Yohann Haas, David Mall, Stefan Todorov, Luis Bokma Fernandez, Philipp Barth, Adnan Ügür, ...

www.humanoids.kit.edu



Federal Ministry
of Research, Technology
and Space



Robotics
Institute
Germany



Carl Zeiss
Stiftung

HERON
Robotics Excellence

Thank you!

Daide Matteri



Kranjska Gora, Slovenia



Collaborative Robotics: Decoding the Human Factors

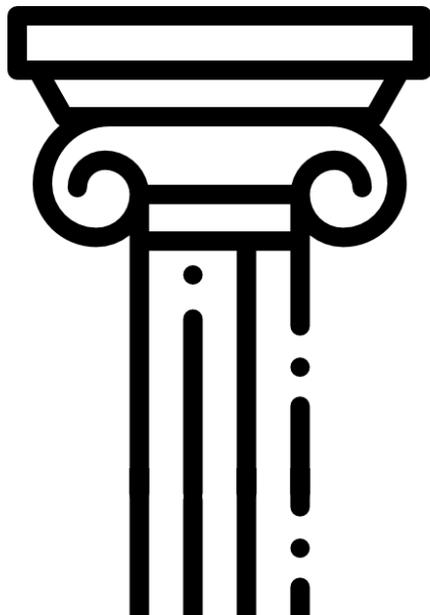
Davide Matteri
MSc, Scientific Collaborator
Management & Industrial Engineering



Technologies Enabling Human Centricity



Human Centricity



The EU Research and Innovation Group identified **11 key technologies** with impacts on human centricity*



AI & ML



Robotics



Automation

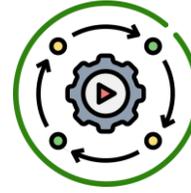


User Interface

...

*EU, 'Industrial Technologies Roadmap on Human-Centric Research and Innovation for the manufacturing sector'

Robotics and Automation



Impacts on HFs during HRC

Industrial robots are physically safe (ISO/TS 15066), but effective integration requires calibrating the human mind, not just the sensors. We isolated four critical Human Factors (HFs):

Mental Workload: The cognitive demand imposed by the task (measured via NASA-TLX).

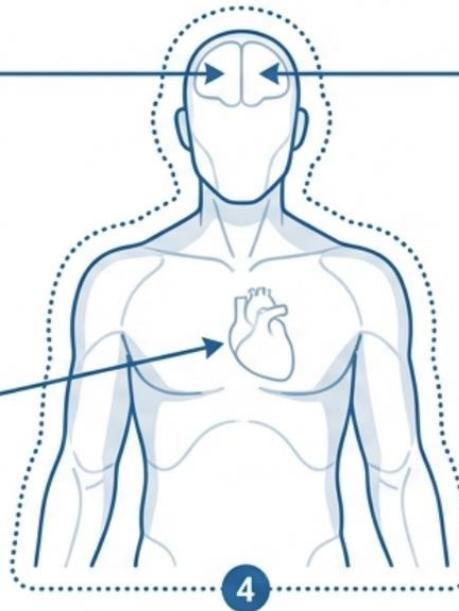
3

Trust: The belief in the system's current reliability and competence.

1

Anxiety: State uneasiness arising from uncertainty or perceived threat (measured via STAI).

2

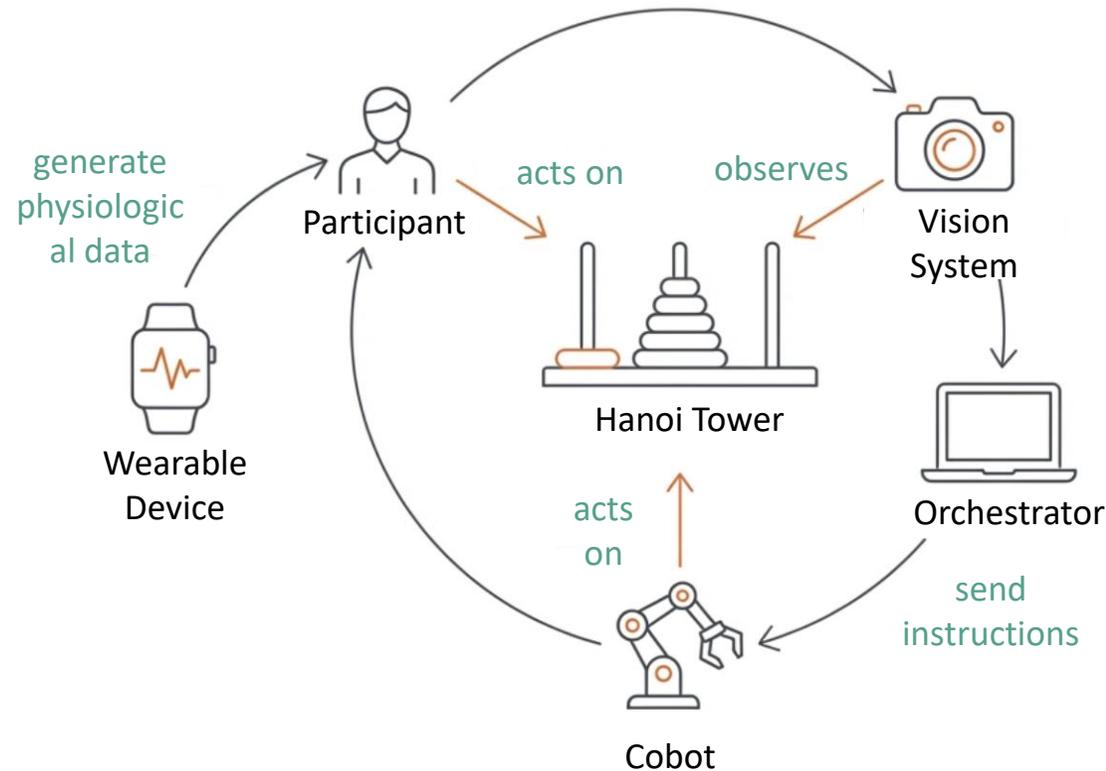


Propensity to Trust: The inherent inclination to trust the machine before and during interaction.

4

Robotics and Automation

The Experiment



The Task: Solving the mathematical puzzle by moving disks on three pegs. It requires strategic planning and generates cognitive stress.

The Robot's Role: The cobot (leader or follower) performs physical moves based on computer vision algorithms.

The Objective: To understand impact of some features (size and speed of the cobot, collaboration mode) on some HFs (trust, mental workload and anxiety).



Robotics and Automation



The Considered Features

1st Variable: The Hardware (Size)

- Comparing the Igus ReBel (Small, lightweight) vs. ABB GoFa (Large, industrial reach)

2nd Variable: The Behaviour (Speed)

- Comparing a fast mode (1500 mm/s) vs. slow mode (300 mm/s)



3rd Variable: The Logic (Collaboration Mode)

- Triggered Collaboration: Human manually signals the robot
- Alternated with Countdown: Robot moves automatically every 5 seconds
- Mixed Collaboration: Turn-taking swaps after 7 moves



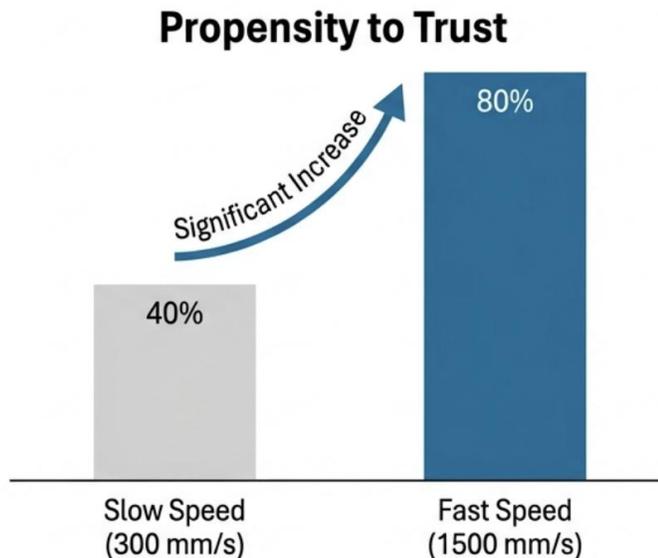
The dashboard

Robotics and Automation

Some Findings

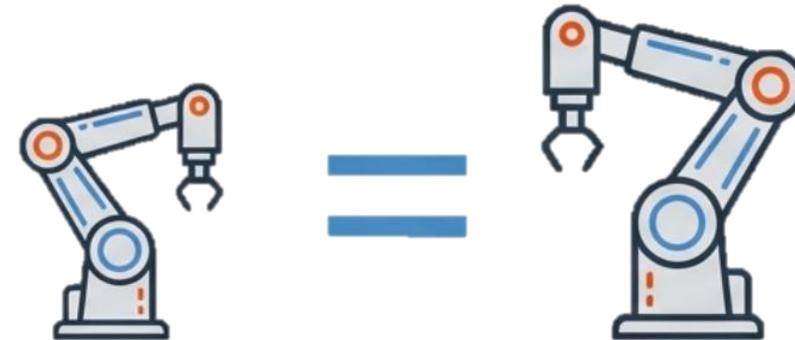


Insight A: Speed Builds Confidence



Higher cobot speeds increased the propensity to trust ($p = .004$). Participants felt more confident when the robot moved decisively. Slow speeds were perceived as inefficient

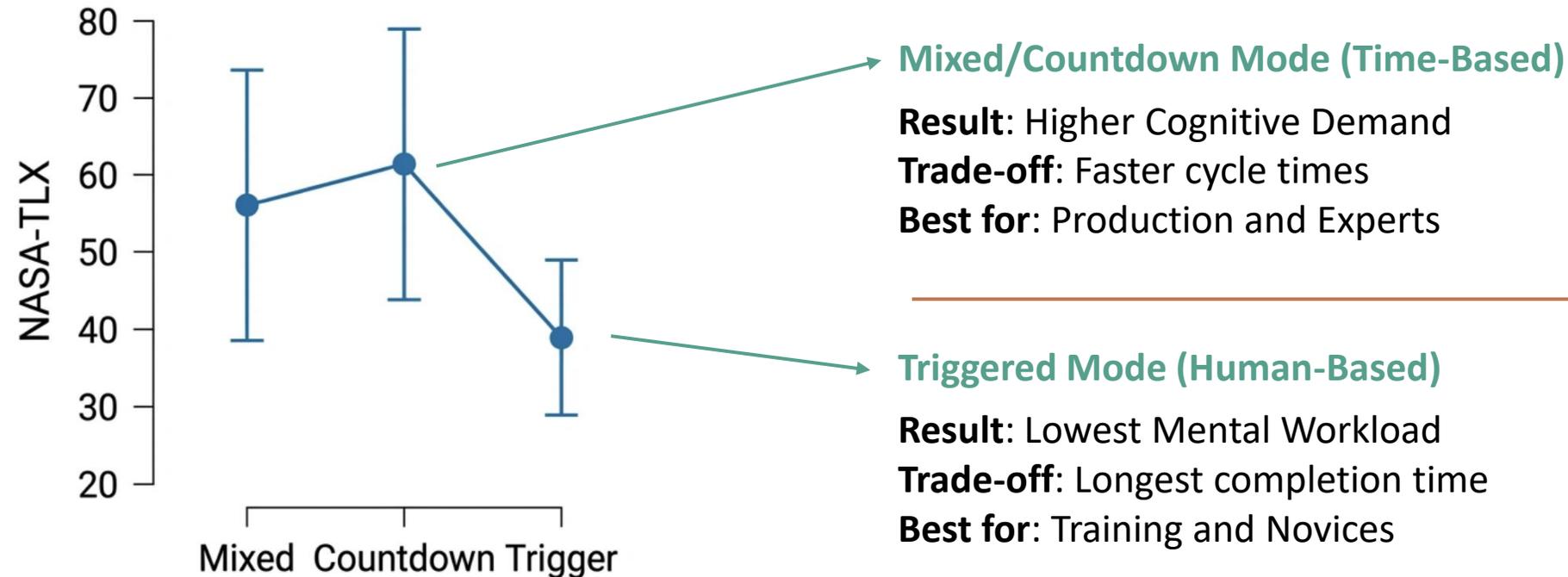
Insight B: Size is Neutral



No significant difference in Anxiety or Trust based on robot size. Larger cobots do not inherently intimidate workers if safety protocols are met

Robotics and Automation

Some Findings





Kranjska Gora, Slovenia



SUPSI

Sustainable
Production
Systems
Lab

Thanks

Filippo Brasina

Strategies for Co-manipulation of Bulky, Soft-Packed Items

Filippo Brasina, Roberto Di Leva, Marco Carricato



Department of Industrial Engineering
University of Bologna
40136 Bologna, Italy

- **SiMOD Project Context**

Mobile cobots to handle deformable items (*e.g.*, soft packs, cables)

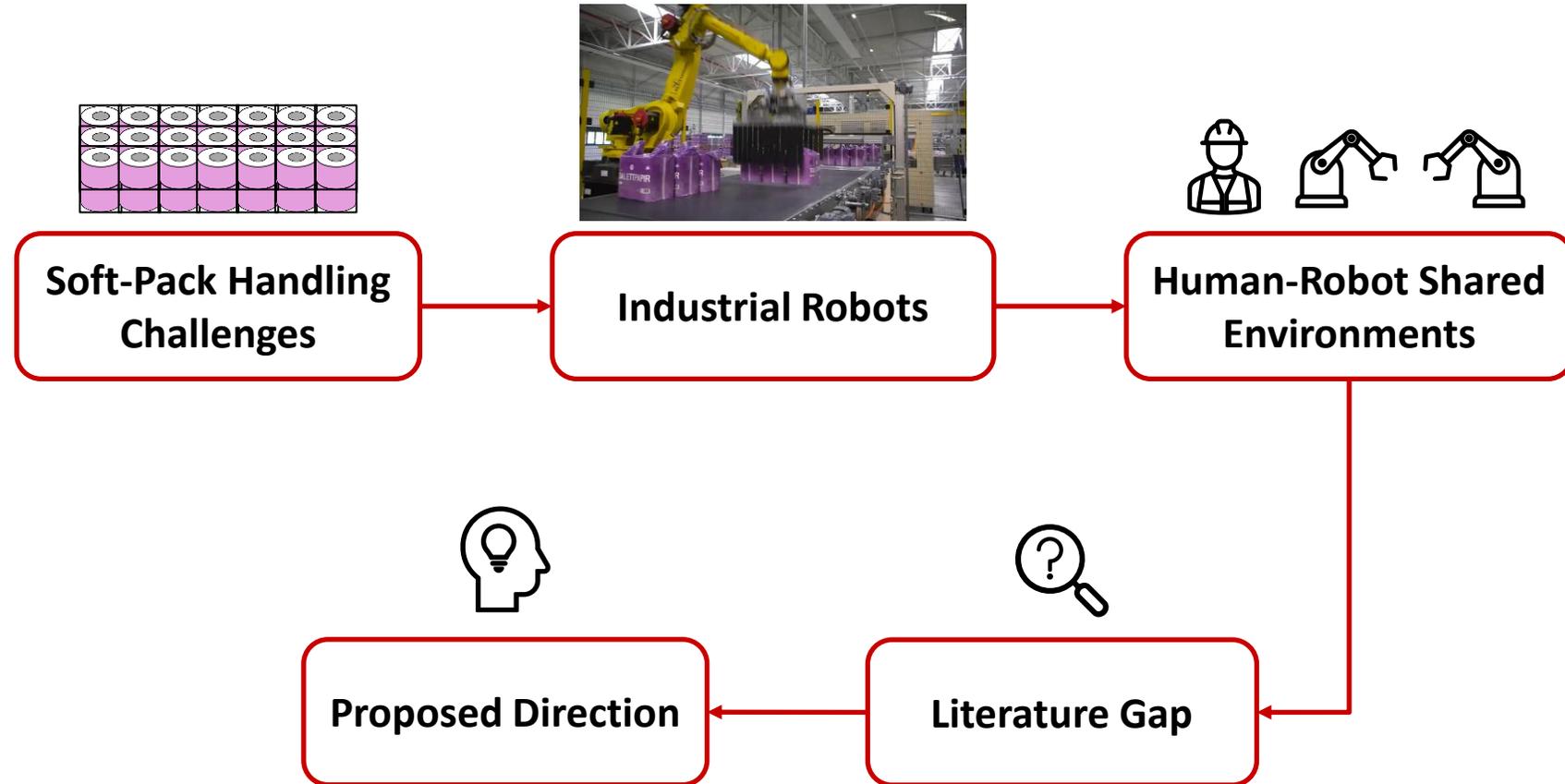
Perception & co-manipulation to work in semi-structured spaces

Reduce physical and cognitive load for workers

SiMOD



Strategies for Co-manipulation of Bulky, Soft-Packed Items



Strategies for Co-manipulation of Bulky, Soft-Packed Items

- **Dual-Arm Manipulation**

Warehouse lift of bulky and soft-packed goods

Challenges: shape preservation and stable lift





ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Thanks for your attention

Filippo Brasina

filippo.brasina2@unibo.it

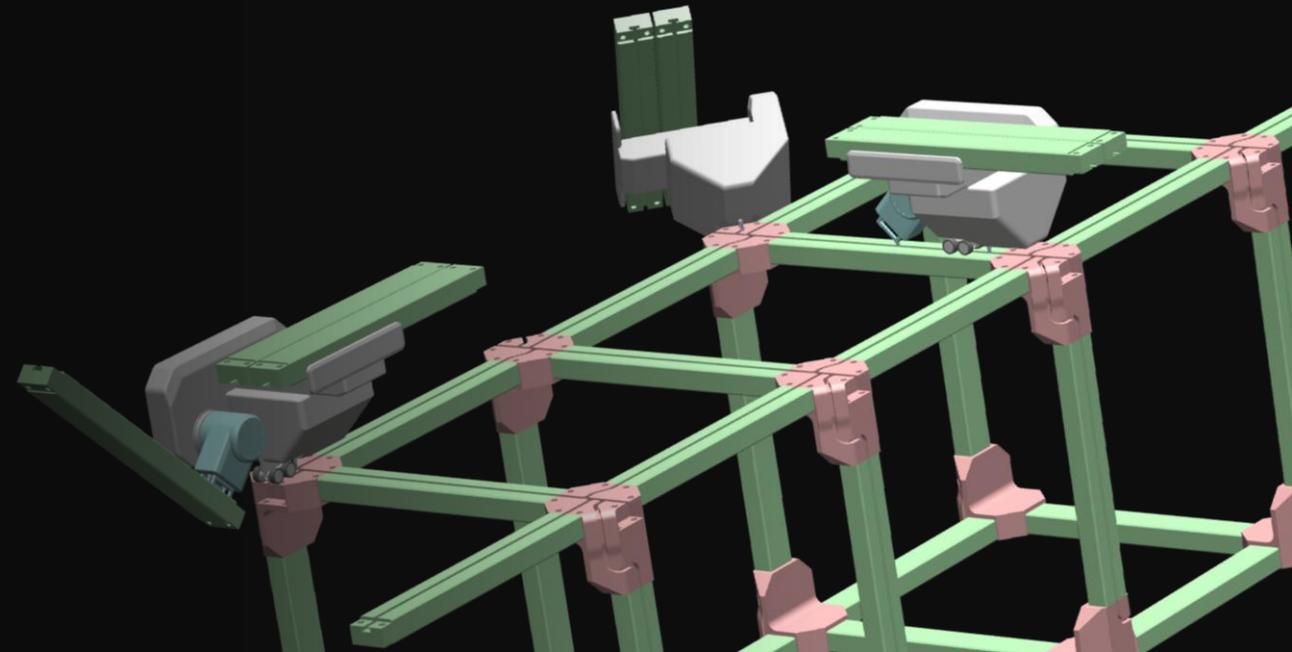
DIN – University of Bologna

Francesco Buso

Under Pressure and Out of Air: Advancements in Wave Energy Conversion and In-orbit Manufacturing



Francesco Buso, University of Trieste

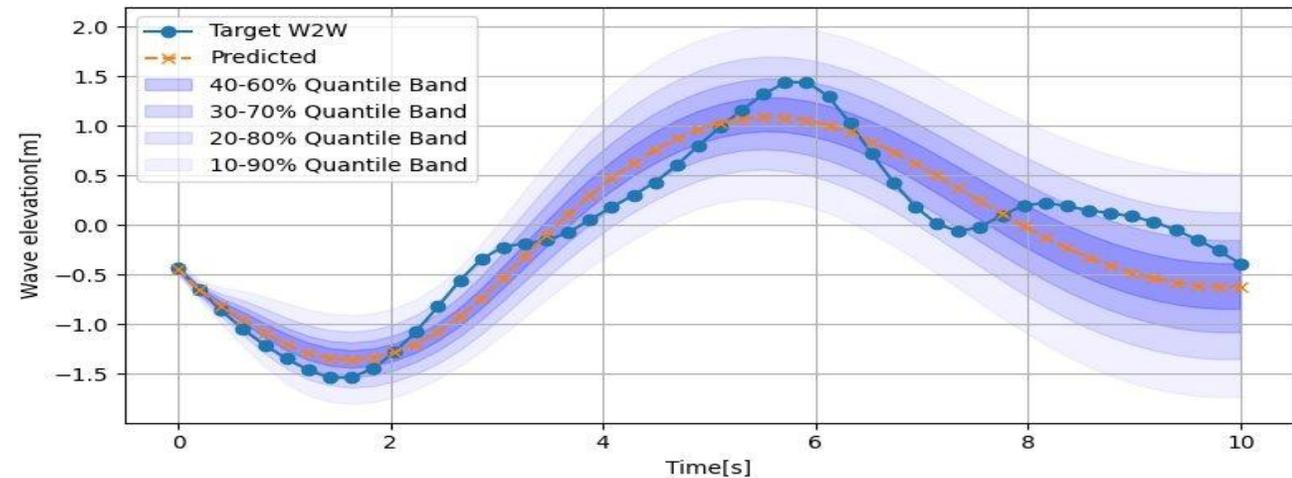
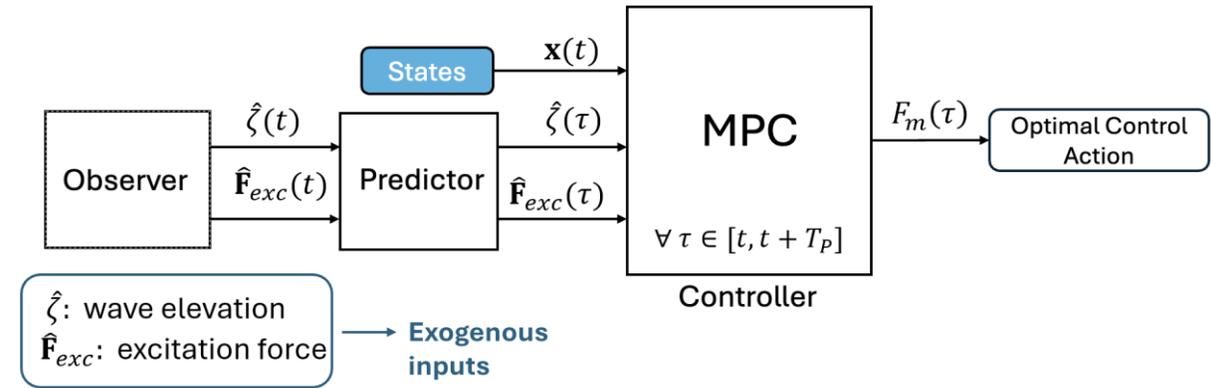


Short-term forecasting of wave elevation and excitation force for wave energy converters (WEC)

- **Industry Partner:** CorPower Ocean AB (Stockholm)
- **Focus:** Predicting wave elevation and excitation force to optimize WEC performance.

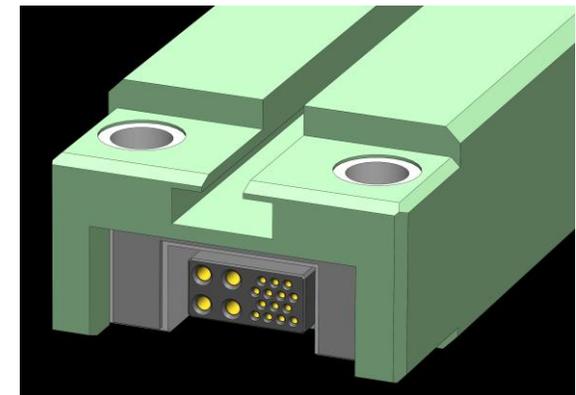
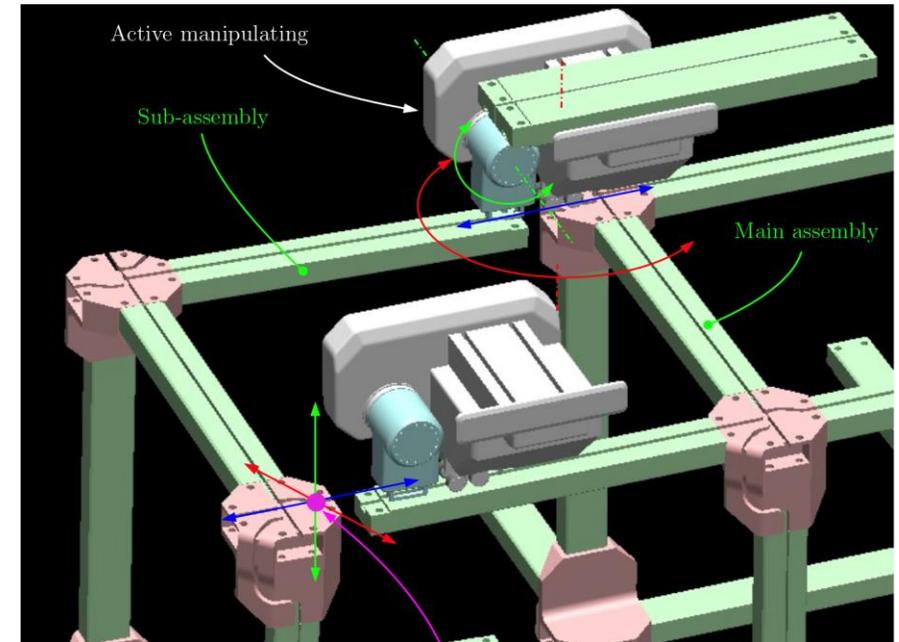


Development and comparative evaluation of several strategies for short-term forecasting of the two exogenous input

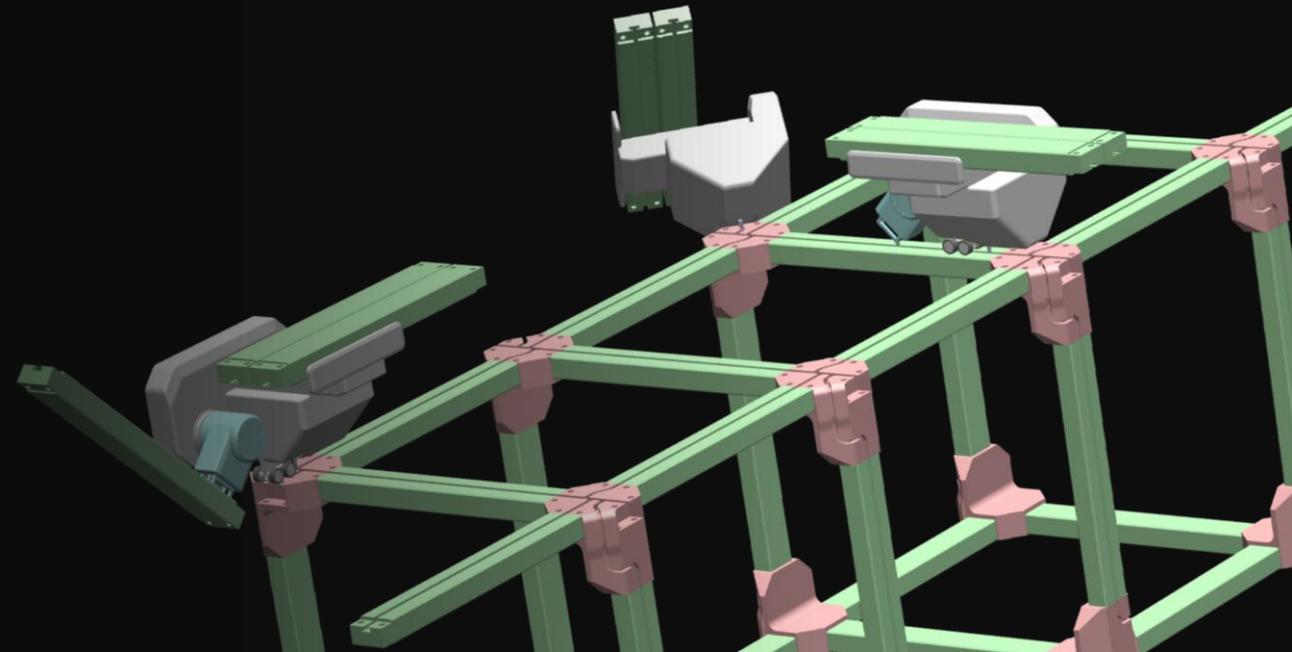


Robotics-Enabled Assembly of Large In-Orbit Structures with Embedded Electronics

- part of the **ESA LATTICE** campaign
- cross-disciplinary methodology for large-scale space structures
- **Core principles:**
 - Modular Structure with Integrated Electronics
 - Tethered On-Track Robots
 - Low-DOF Assembly
 - Structure-Embedded Sensors & Actuators



Thank you for your attention!
Feel free to reach out to me if you have any
questions.



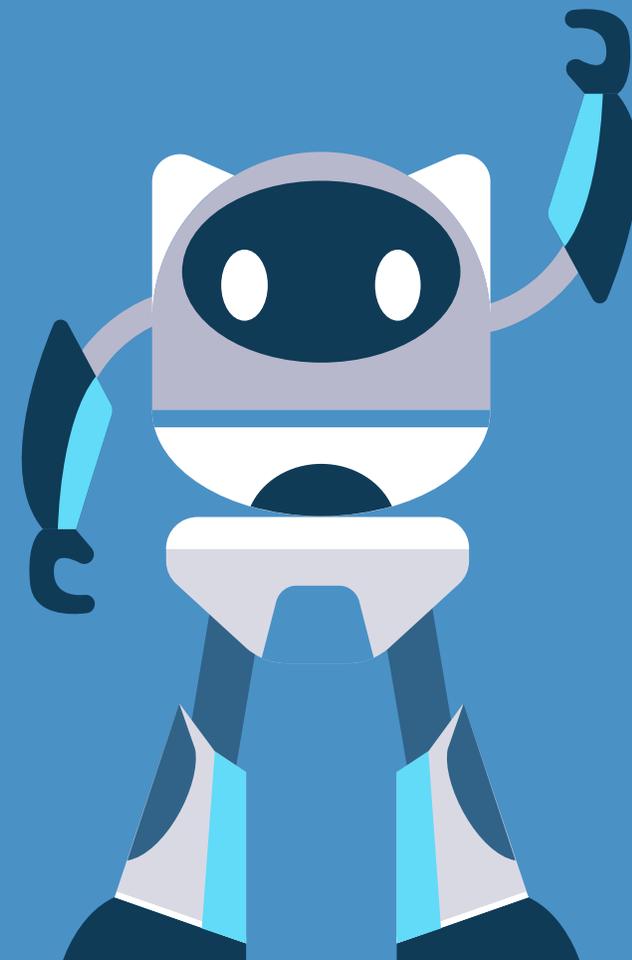
Igor Babić



Igor Babić

Ph.D Student in Mechatronics

Romantic project
Winter School 2026
Kranjska Gora, Slovenia



University of Novi Sad
Faculty of Technical Sciences
Chair of Mechatronics, Robotics and Automation

■ Who am I?

01 Education

B.Sc. in Mechatronics, Robotics and Automation

Faculty of Technical Sciences, University of Novi Sad

2018 - 2022

Thesis: *“Model identification and optimal setting of PID controller parameters using genetic algorithm”*

M.Sc. in Mechatronics, Robotics and Automation

Faculty of Technical Sciences, University of Novi Sad

2022 - 2023

Thesis: *“Development of robot cell with SCARA robot for handling motor stators”*

Ph.D. in Mechatronics, Robotics and Automation

Faculty of Technical Sciences, University of Novi Sad

2023 - present

02 Appointments

Teaching Assistant

Chair of Mechatronics, Robotics and Automation

Faculty of Technical Sciences, University of Novi Sad

2022 - present

- Programming and design of robotic systems
- Robotic systems in medicine
- CAD modeling and PLC programming

Member of National Organizing Committee Eurobot Serbia



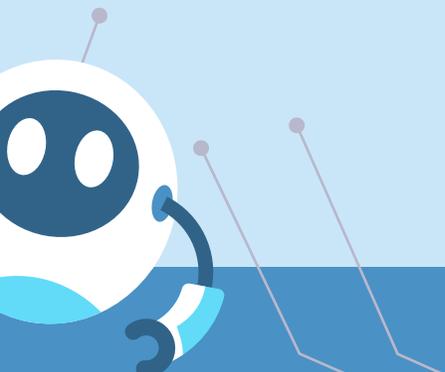
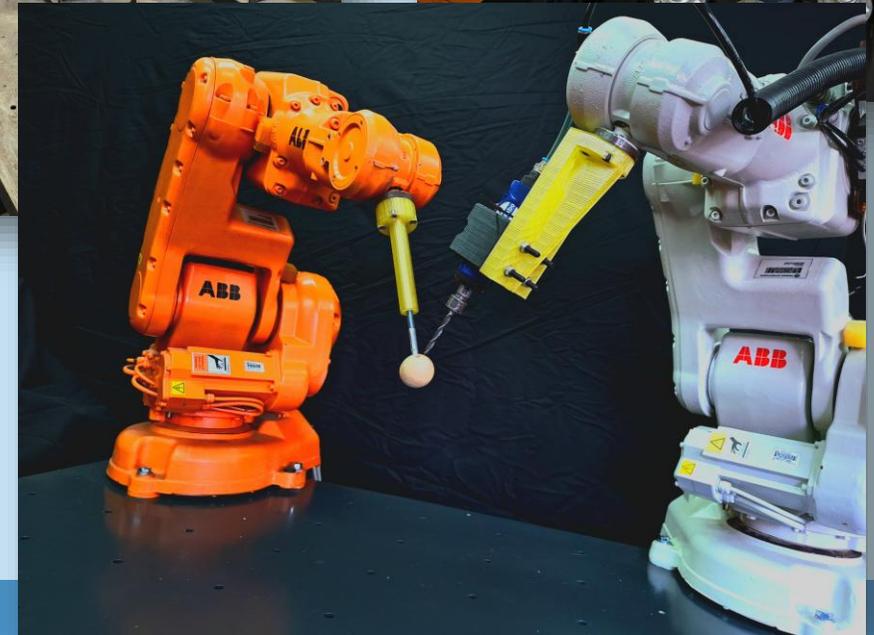
■ What have I worked on?

Research & Industry Experience

- SCARA pick-and-place robotic cell design
- Robotic fabrication in architecture (spherical joints)
- Industrial robot commissioning for welding

Ph.D. Research Interests

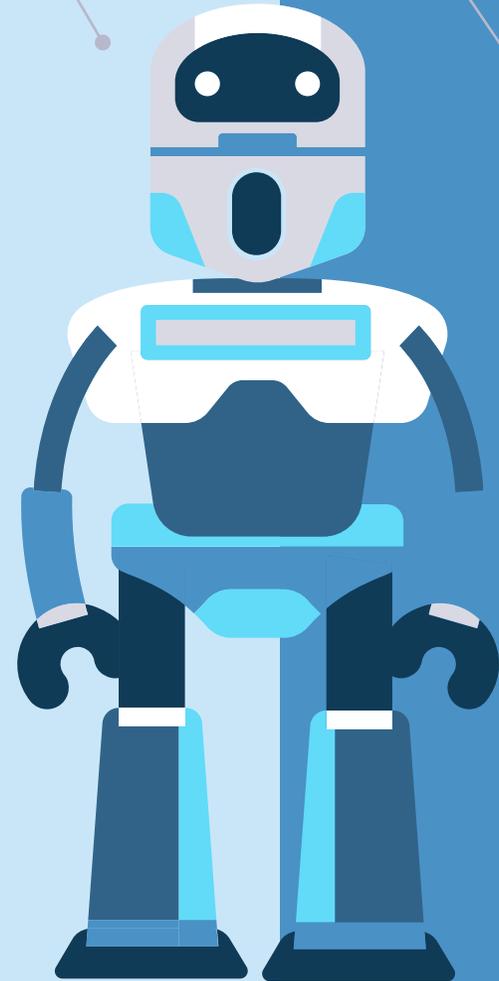
- MuJoCo-based robotic simulation
- Model-based control using Pinocchio (Python)
- Sliding mode and impedance control
- Probabilistic, human-inspired inverse kinematics



■

Thank you for you attention!

I am open to any questions and comments!



Jay Kamat



Institut de Robòtica i
Informàtica Industrial



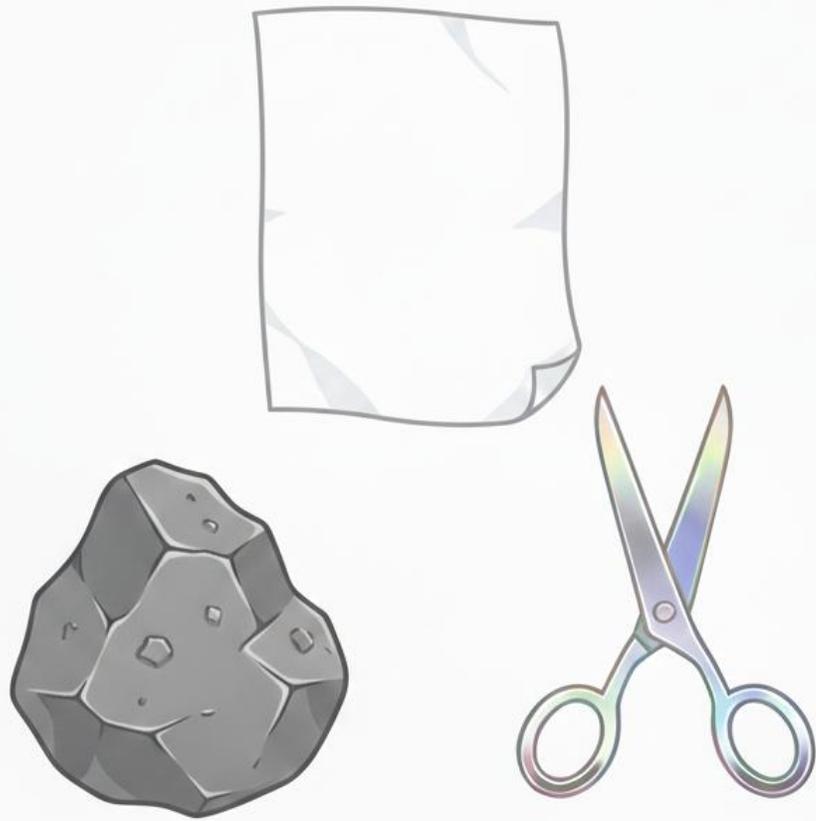
CloSE: A Geometric Shape-Agnostic Cloth State Representation

Jay Kamat, Júlia Borràs, Carme Torras



ROMANDIC

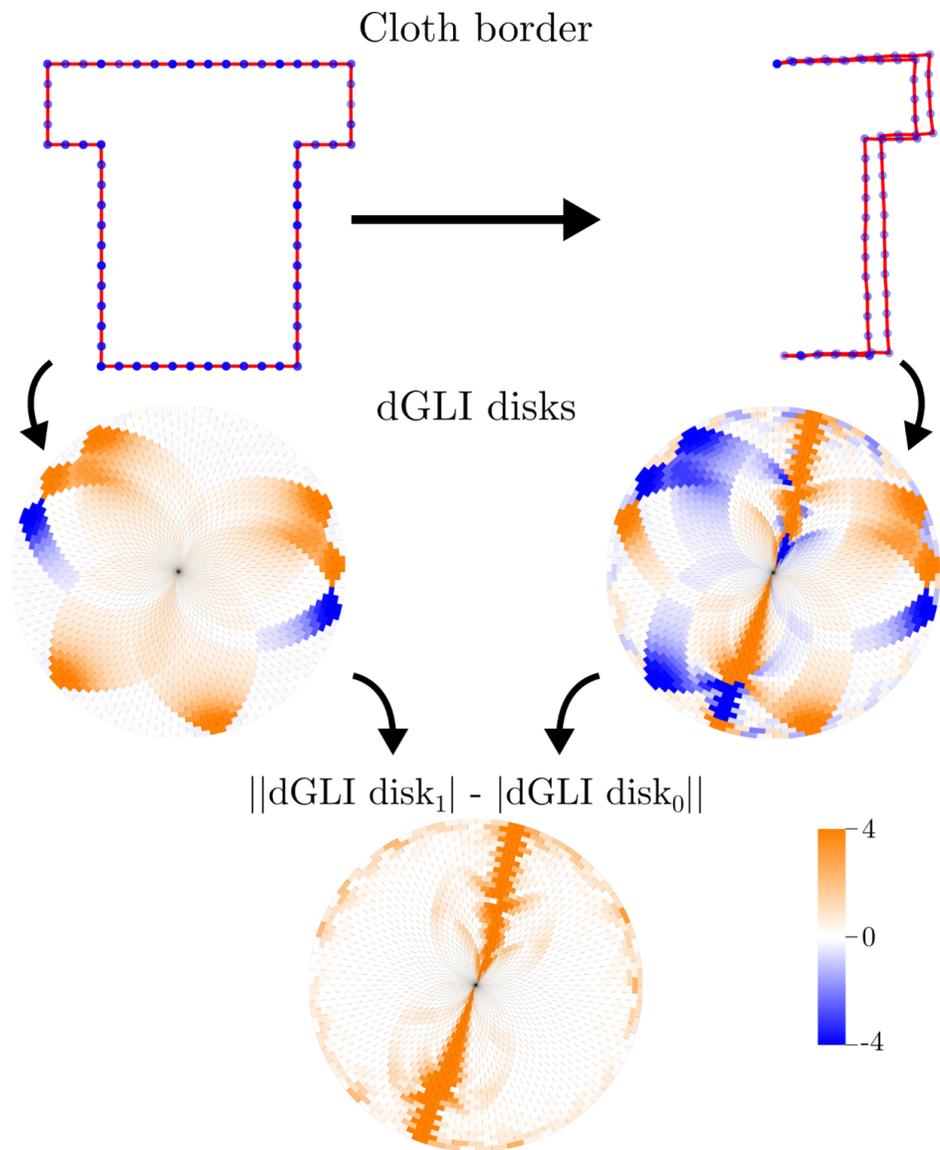




Clothes

- High dimensional C-Space
- Different Shapes and Sizes
- Different Materials

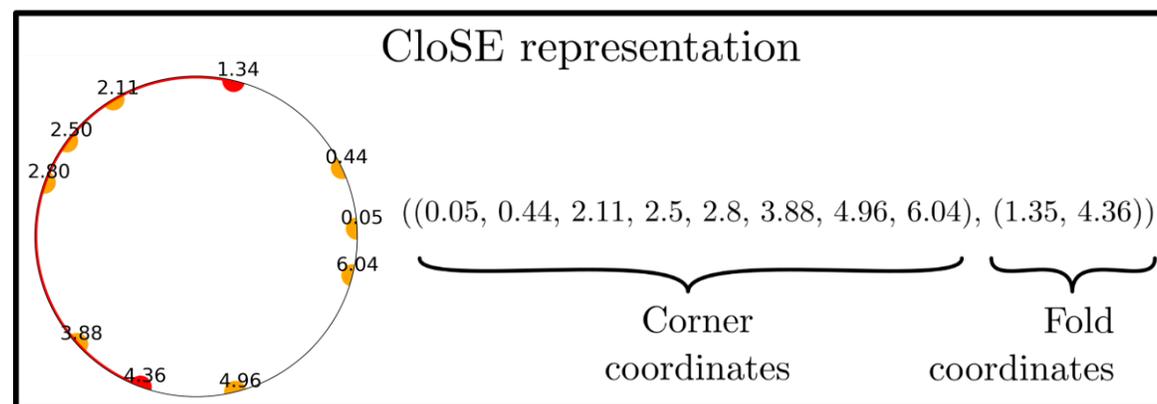


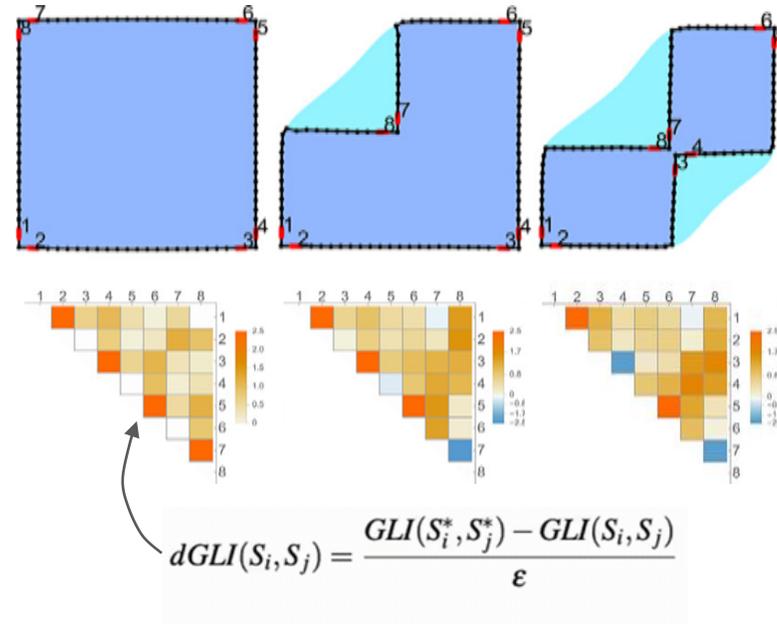
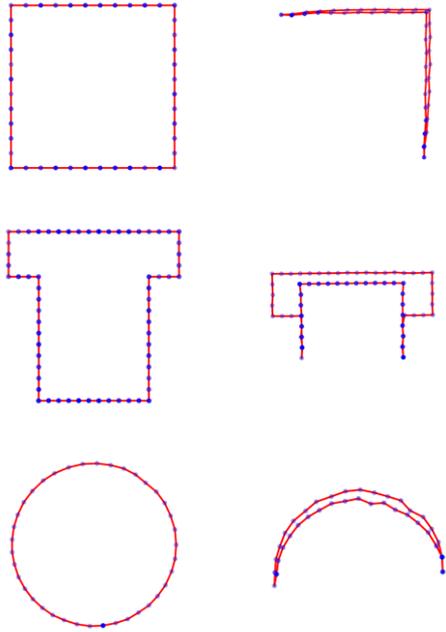


We propose:

A geometric representation that captures the state of the cloth.

Using dGLI - a topological measure





The cloth border is sufficient to describe the state of the cloth for folding tasks

Prior works [1,2] used the dGLI matrix to distinguish between different cloth states.

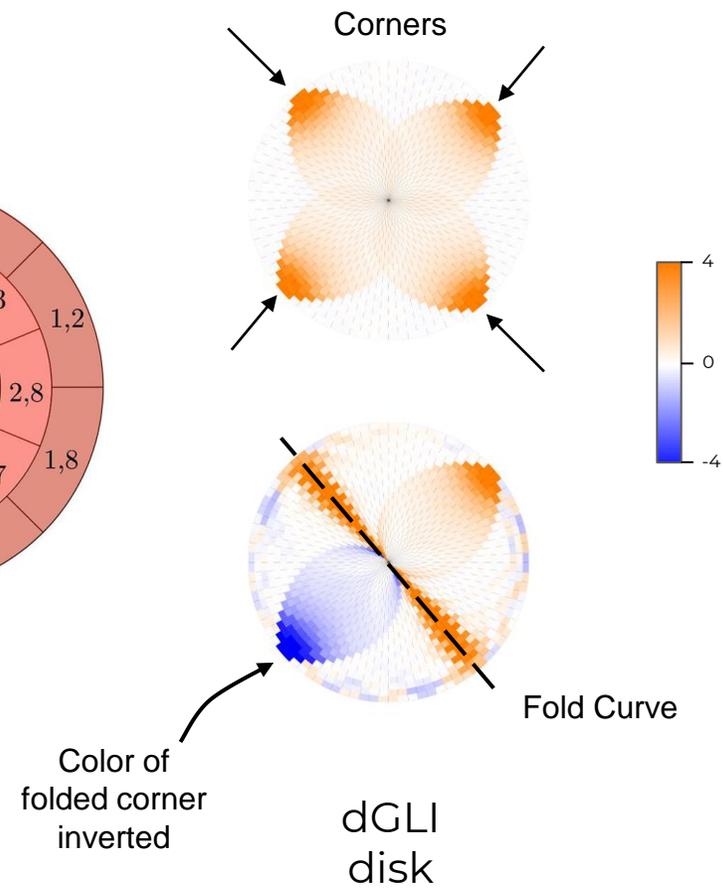
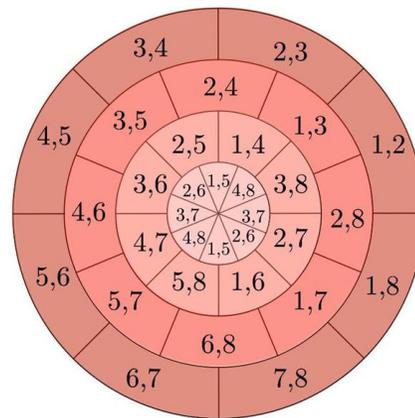
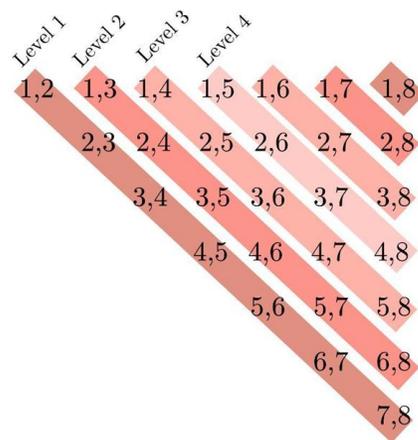
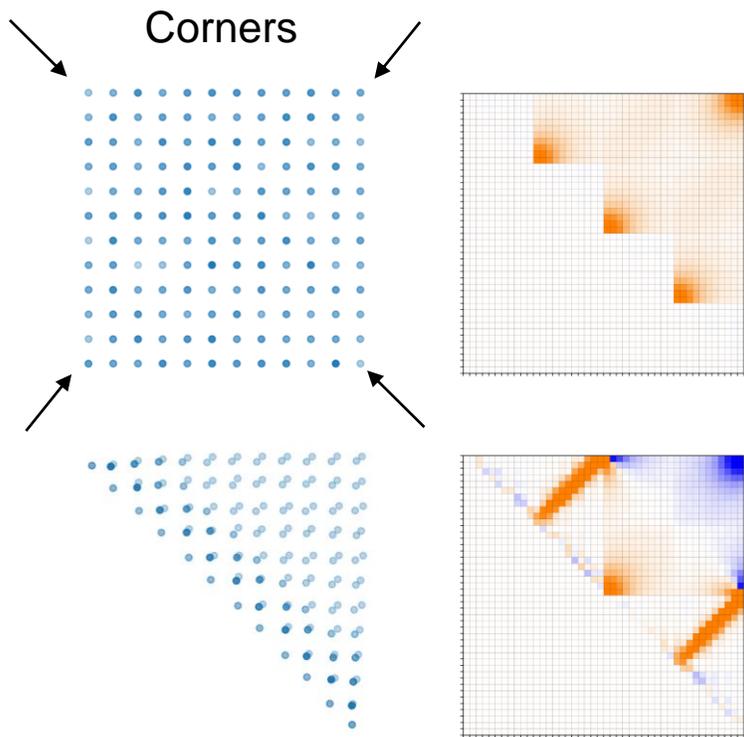
- ✗ Use a few handpicked border segments.
- ✗ Very sensitive to noise on the selected segments

Our method:

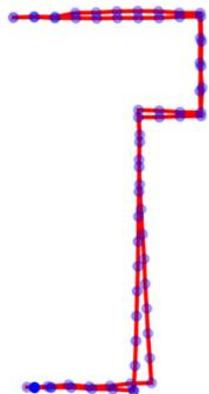
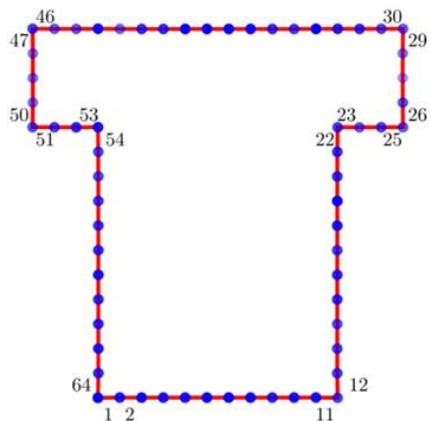
- ✓ Uses all the border edges, capturing more information
- ✓ Rearrange the dGLI values on a circular grid

[1] F. Coltraro, et. al., "A representation of cloth states based on a derivative of the gauss linking integral," Applied Mathematics and Computation, 2023
 [2] J. Borràs, et. al., "A virtual reality framework for fast dataset creation applied to cloth manipulation with automatic semantic labelling," ICRA 2023

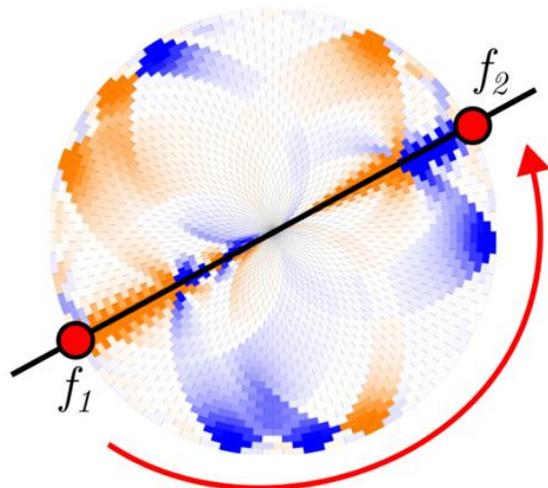
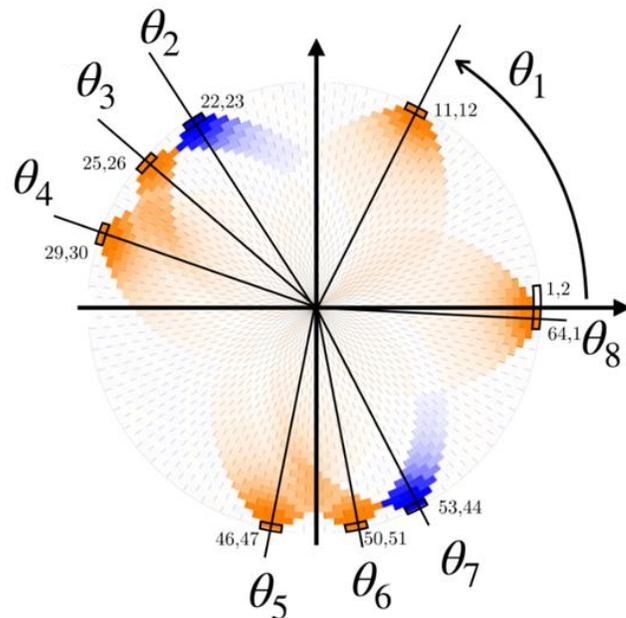
The dGLI disk



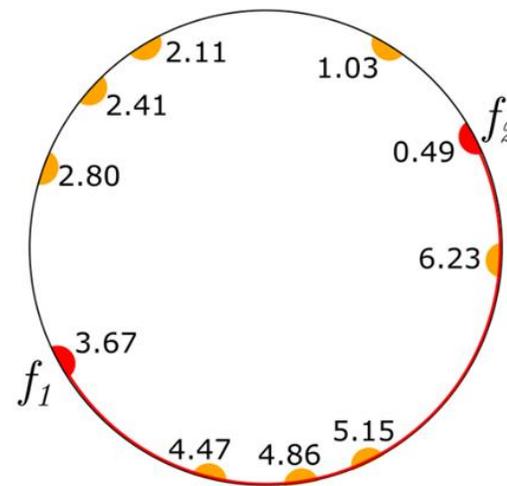
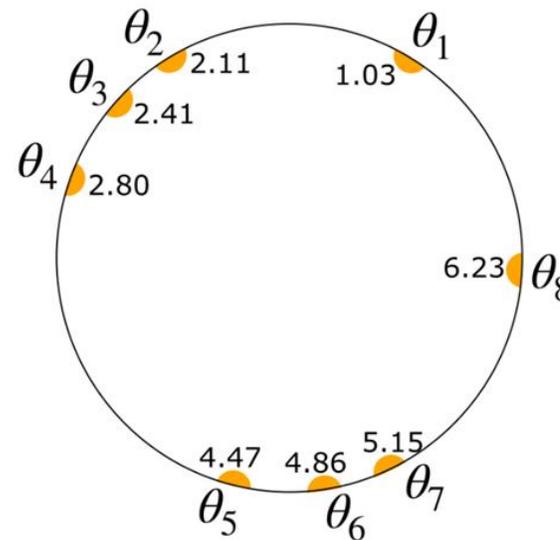
Cloth Border



dGLI disk



CloSE



Invariant to **shape**, **orientation** and **size** of the cloth

CloSE

Corners $\{\theta_1, \dots, \theta_n\}$

Fold (f_1, f_2)

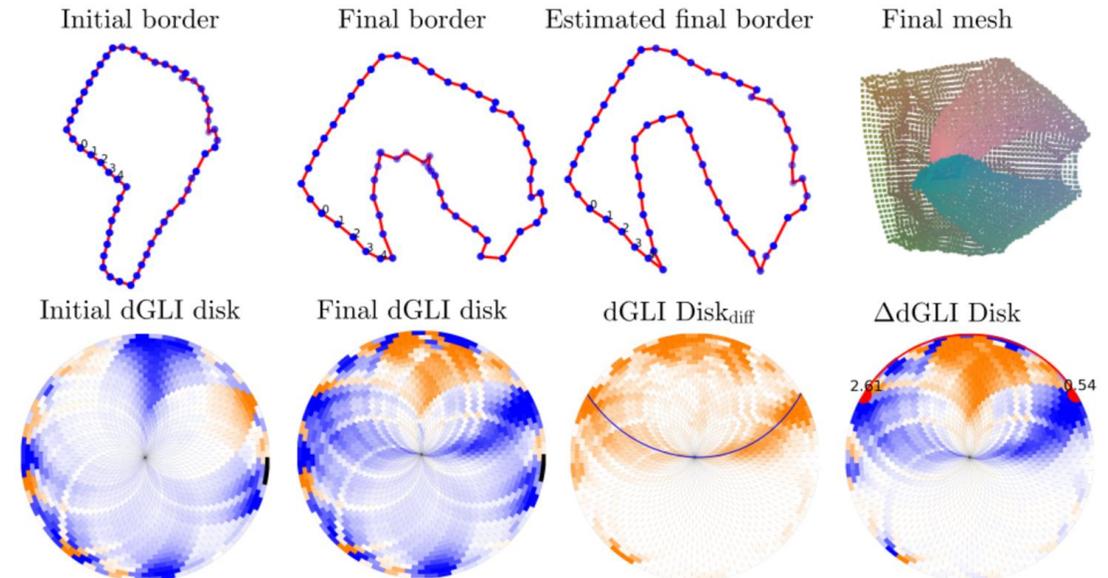
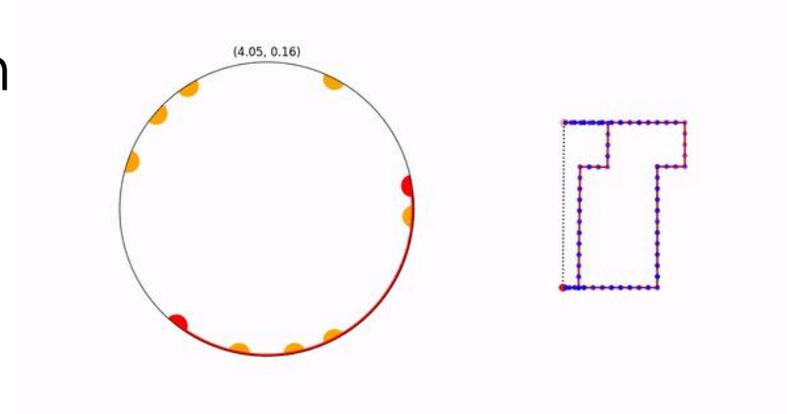
Intuition: think of the CloSE representation as the cloth border morphed onto a unit circle

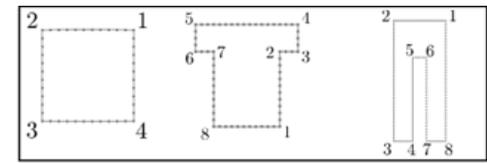
CloSE: A Geometric Shape-Agnostic Cloth State Representation

→ Represent the cloth state by the fold location

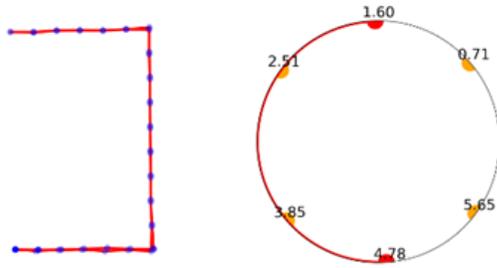
→ General to any shape, size, orientation

→ Able to predict the precise location of the fold. For each new fold, we use the current silhouette border.

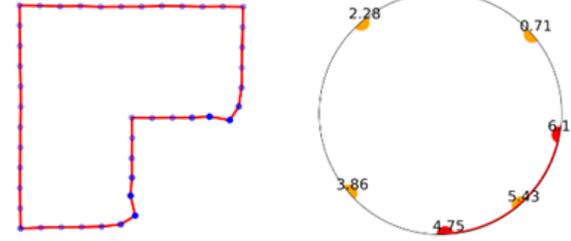




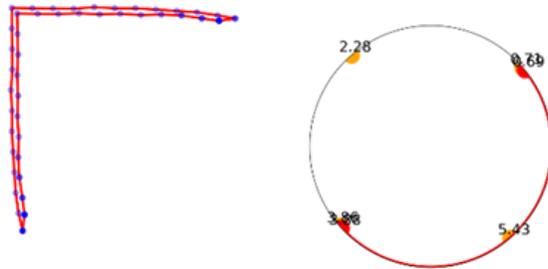
Cloth has 4 corners.
 Corner 4 is folded.
 Corner is 41.9% folded.



Cloth has 4 corners.
 Corners {2, 3} are folded.
 Cloth is folded in half
 Side 12 is 50.9% folded
 Side 34 is 51.9% folded



Cloth has 8 corners.
 Corners {5, 6, 7, 8} are folded.
 One side folded
 Side 45 is 38.4% folded
 Side 81 is 32.1% folded

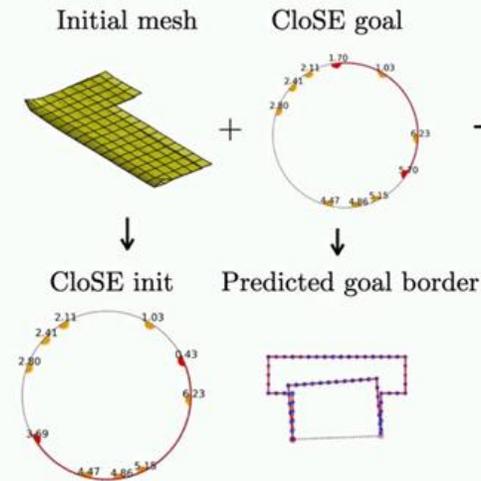


Cloth has 4 corners.
 Corner 4 is folded.
 Diagonally folded in half
 Corner is 97.% folded.

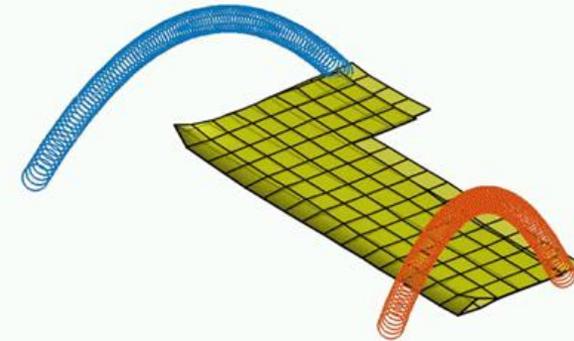


Planning II (different semantic regions)

Inputs:

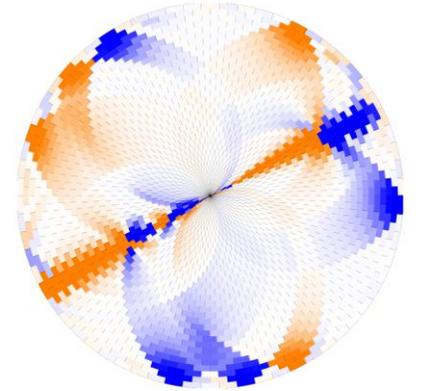


Step 1: Unfold corner(s): [5, 6, 7, 8]
 across line: (3.69, 0.43)
 Step 2: Fold corner(s): [1, 8]
 across line: (5.70, 1.70)

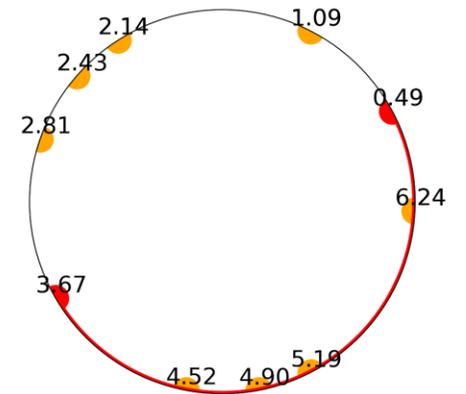


Contributions:

1. The dGLI disk: a new arrangement for the dGLI coordinates in a disk instead of a matrix, which unravels a hidden structure that is *general to any shape, size and pose of the cloth*.



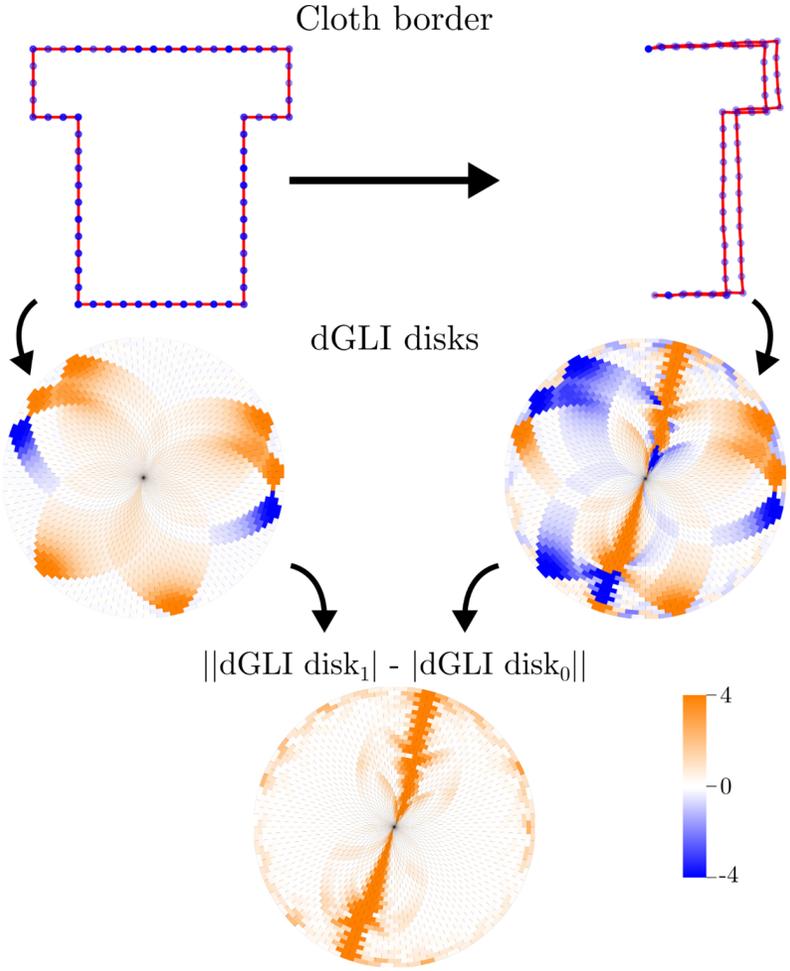
1. CloSE: An abstraction of the dGLI disk onto a circle that is *compact and continuous*.



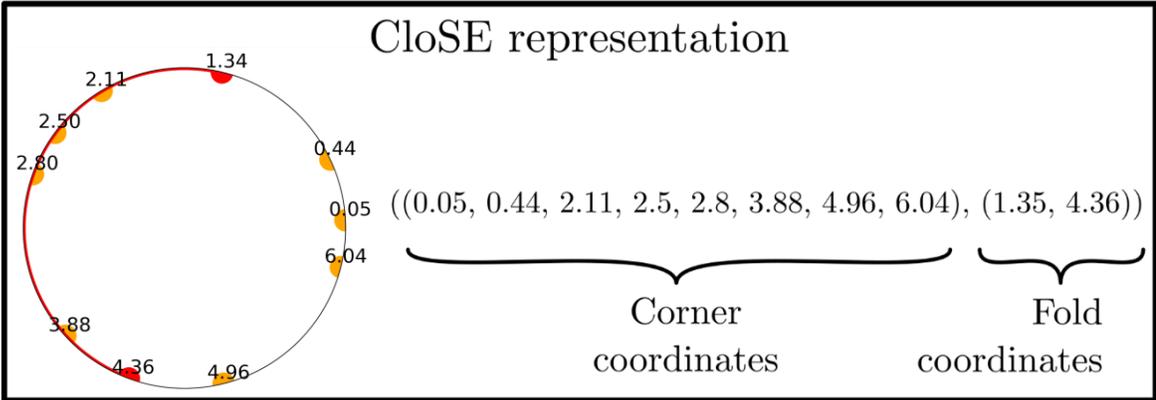
1. Two applications of the CloSE representation:

- a. Automatic semantic description of the cloth state
- b. Planning manipulation sequences

CloSE: A Geometric Shape-Agnostic Cloth State Representation



<https://close-representation.github.io/>



Mathilde Kappel

Towards Robust Prehensile Manipulation in Open-Ended Environments

Mathilde Kappel¹
2nd year PhD Student



Pitch presentation Kranjska Gora, Slovenia, February 12th

Supervision : Mahdi Khoramshahi¹, Louis Annabi¹, Faïz Ben Amar¹, Stéphane Doncieux¹

¹Sorbonne University, CNRS, Institut des Systèmes Intelligents et de Robotique, ISIR, **Paris**, France

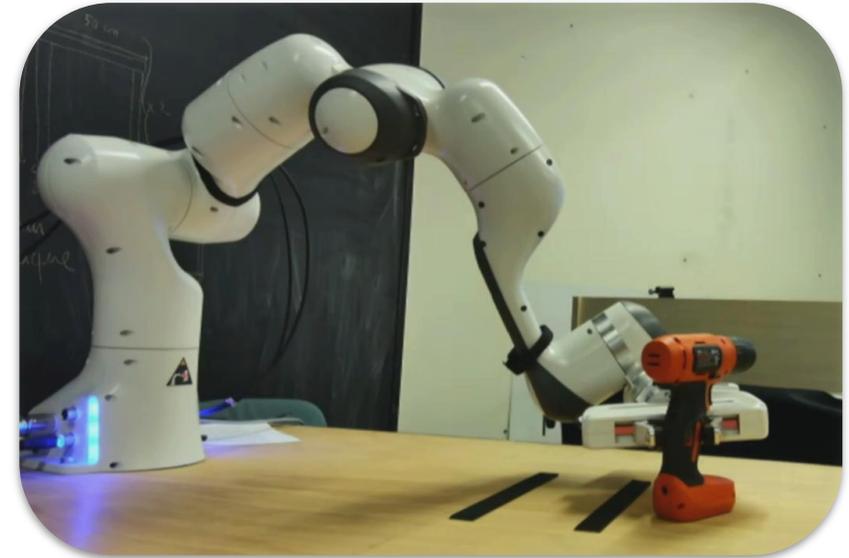


Introduction: Robotic Grasping at ISIR



How to grasp any object ?

<https://qdgrasp.github.io/>



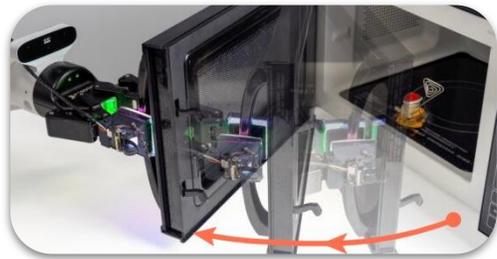
Thesis work : How to **manipulate** articulated objects ?

[1] J. Huber, F. Hélénon, M. Kappel, E. Chelly, M. Khoramshahi, F. Ben Amar, et S. Doncieux, "Speeding up 6-DoF Grasp Sampling with Quality-Diversity", IROS 2024

[2] J. Huber, F. Hélénon, M. Kappel, I. de Loyola Páez-Ubieta, S. T. Puente, P. Gil, F. Ben Amar, et S. Doncieux, "QDGset: A Large Scale Grasping Dataset Generated with Quality-Diversity", ICRA 2025

Challenge: Data-driven methods for robotic manipulation

Real world demonstrations



[1]

Automatic demonstrations



[2]

Autonomous manipulation



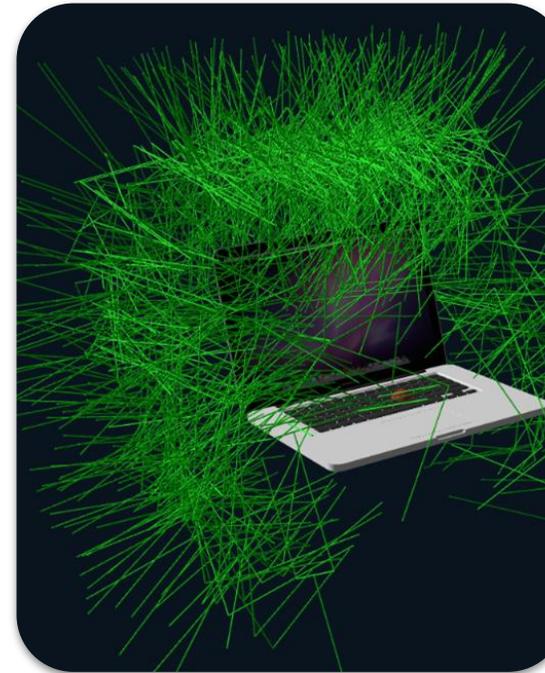
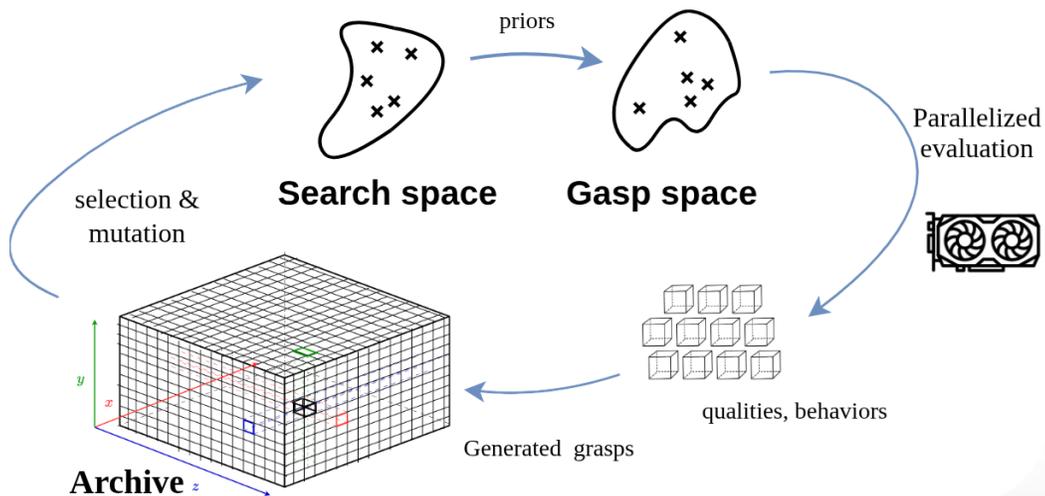
How to automatically generate object manipulation demonstrations for robot learning?

[1] Z. Zhao *et al.*, "Tac-Man: Tactile-Informed Prior-Free Manipulation of Articulated Objects," *IEEE Trans. Robot.*, vol. 41, pp. 538–557, 2025

[2] R. Wu *et al.*, "VAT-Mart: Learning Visual Action Trajectory Proposals for Manipulating 3D ARTiculated Objects," Apr. 01, 2022

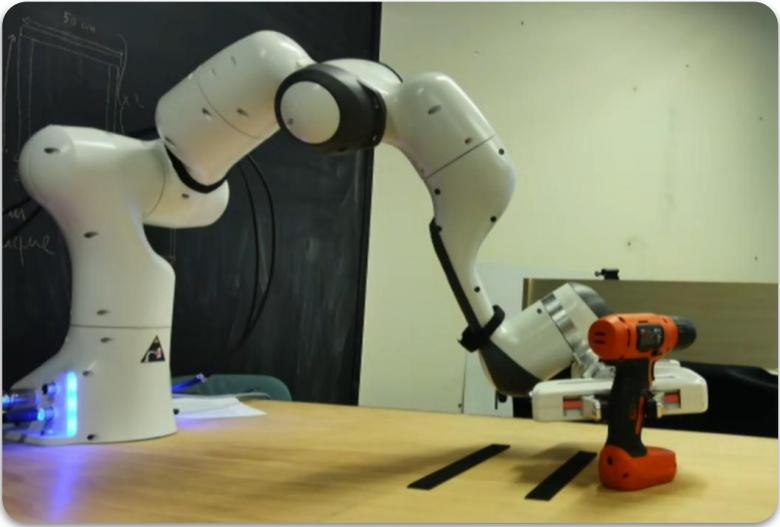
Method: Generation of diverse demonstrations with QD

- Quality-Diversity (QD)
- Evolutionary algorithm
- Excellent exploration properties

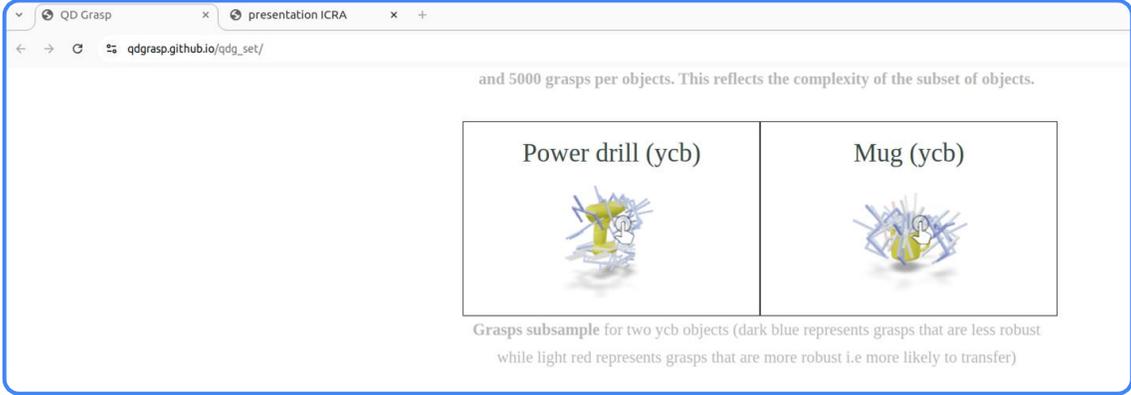


Results: Diverse deployments

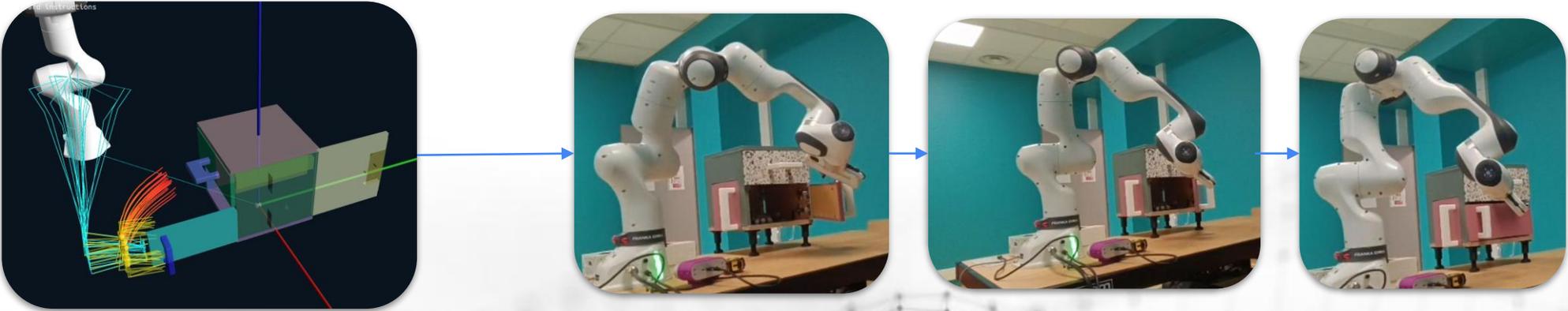
Grasping



62M grasps on about 40K objects



Manipulation



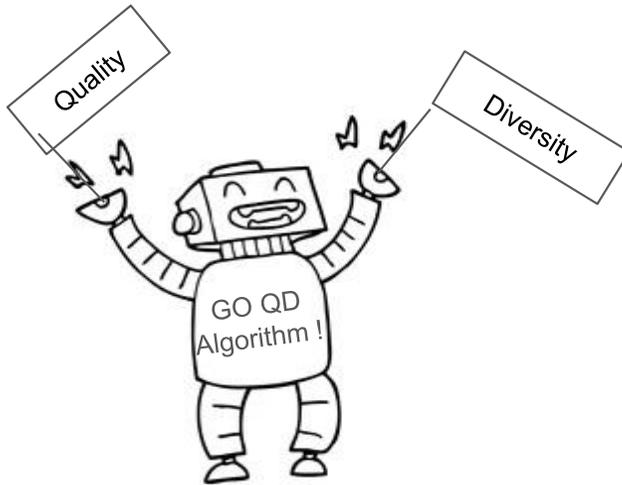
Towards Robust Prehensile Manipulation in Open-Ended Environments

Mathilde Kappel¹
2nd year PhD Student

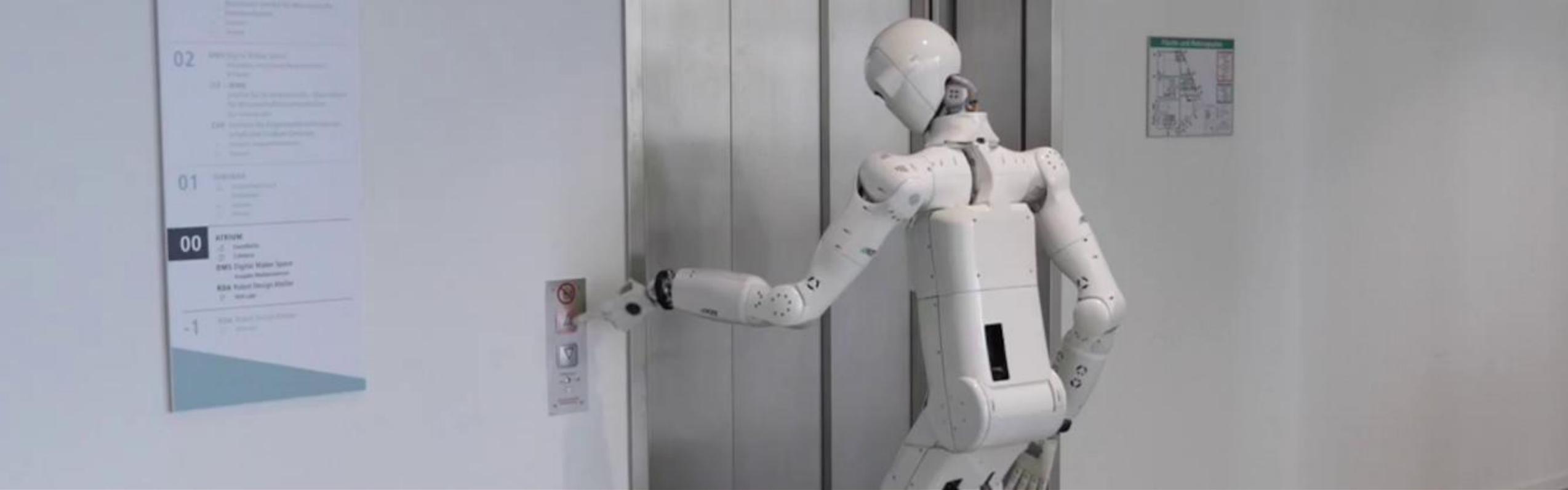


Thank you for listening

kappel@isir.upmc.fr



Niklas Arlt



A Robot That Uses Elevators

Niklas Arlt

High Performance Humanoid Technologies (H²T)

Institute for Anthropomatics and Robotics (IAR)

Karlsruhe Institute of Technology (KIT)

Challenges Riding an Elevator

Where should I position myself?



Can I press the button myself?



Can I move in now or is the path blocked?



Two Strategies to Take an Elevator

Autonomous Strategy



Press button



Wait for exiting humans

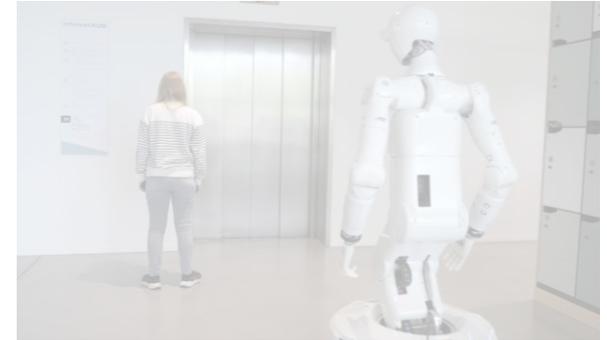


Moving into the elevator



Human-aware positioning

Help-Seeking Strategy



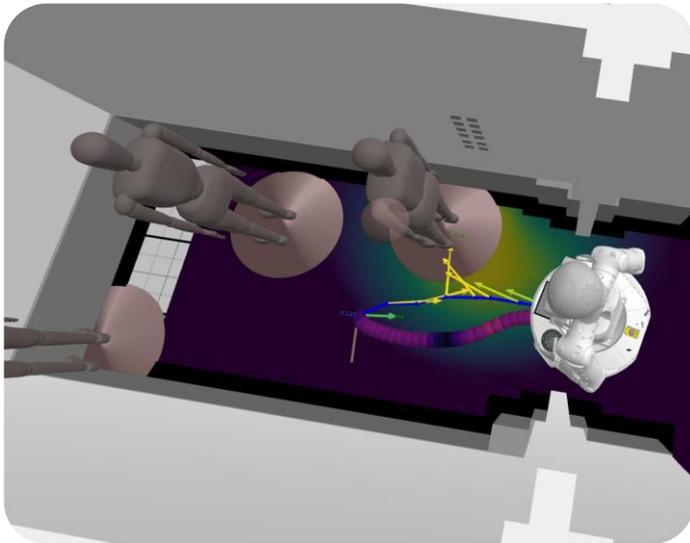
Press the button

Please move

Where Should I Stand?

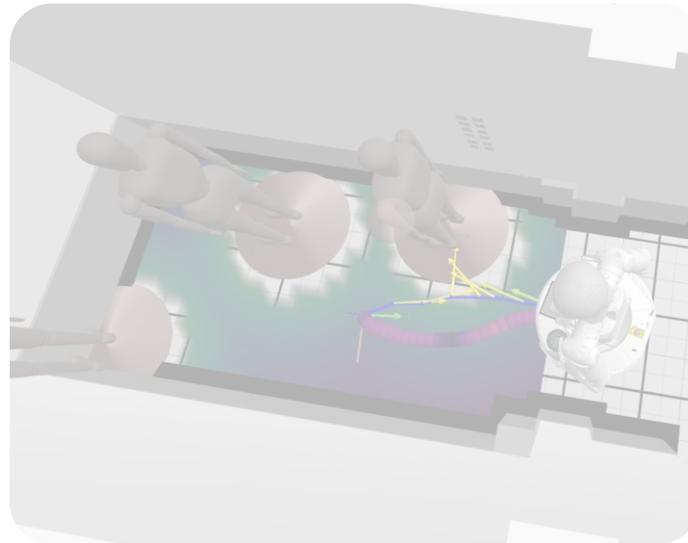
Affordances

- Elevator Interior (preferred)
- Button Panel (avoid)



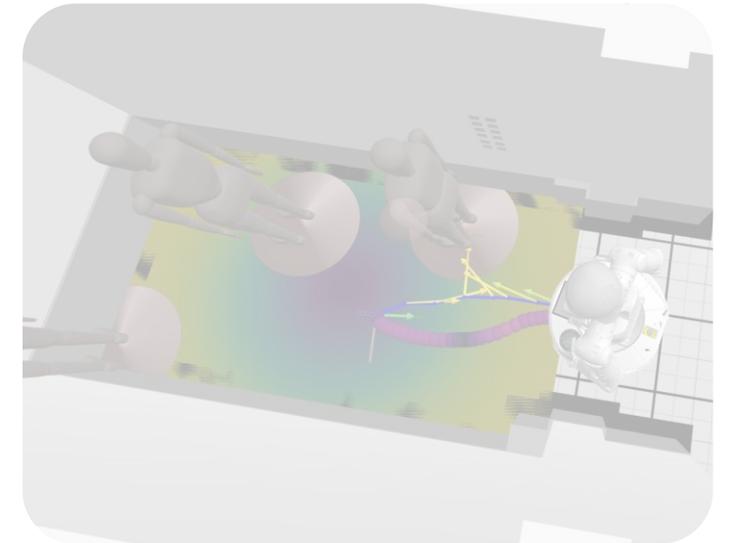
Social Acceptability

- Keep distance from humans



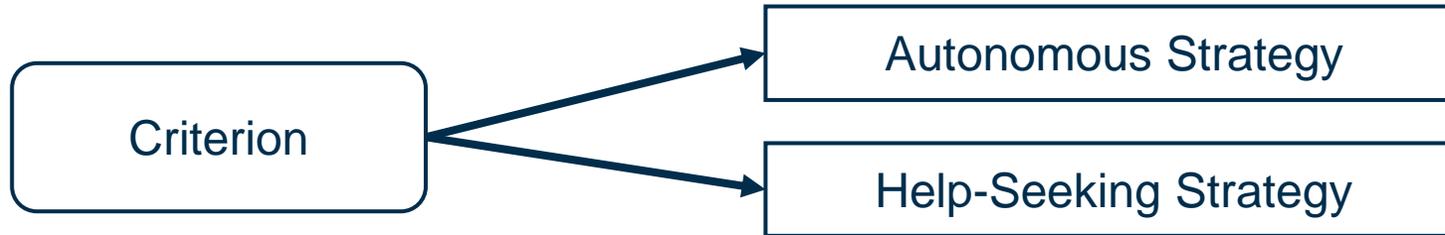
Preferences

- Center of room
- Prefer shorter paths

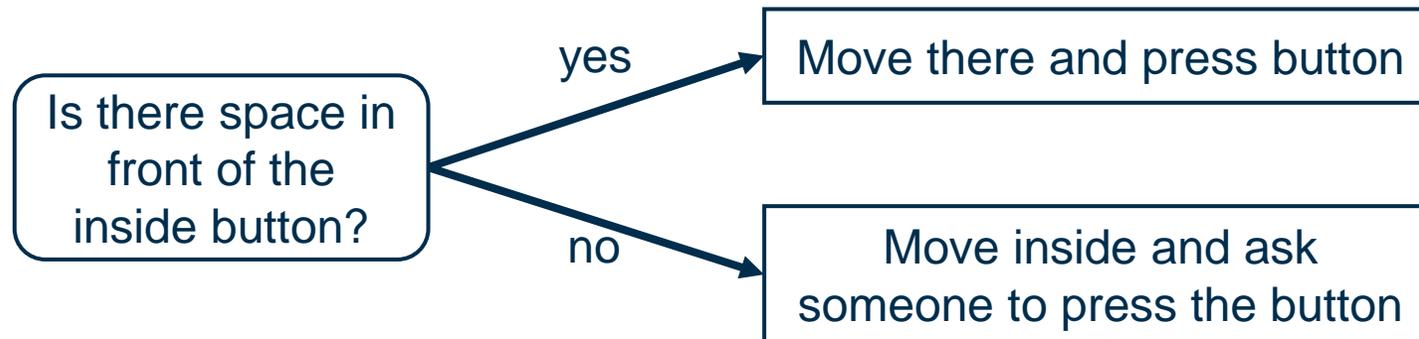


Strategy Switching

Idea



Example



Current Work – Pushing a Serving Cart

Trajectory Planning

Using grid-based search in 3D
(x, y, orientation)

... but that is slow

Goal

Get rid of grid requirement to
allow for fast re-planning





Niklas
Arlt



Tamim
Asfour

www.humanoids.kit.edu



Thank you!

O. Leon Barbed

Image Representations for Geometric and Semantic Scene Understanding: Robotics and Endoscopy

by Óscar León Barbed Pérez, PhD
Robotics Expert @ BSH (Spain)



B/S/H/

For Winter School in Kranjska Gora (Slovenia), Feb 9-13th 2026

About me

O. León Barbed



BSc in Computer Engineering. University of Zaragoza (Spain)

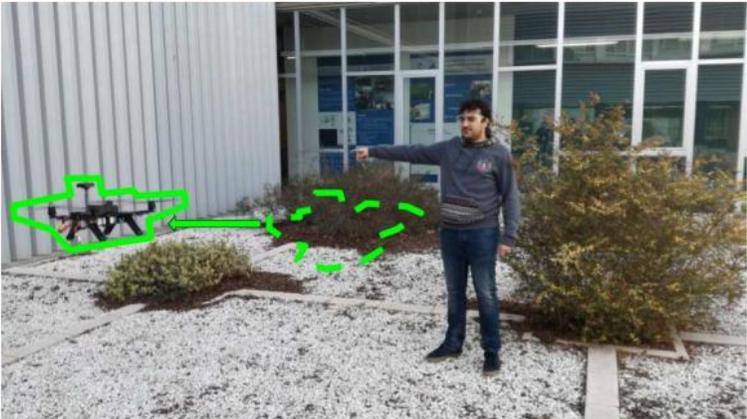
MSc in Modeling, Mathematical Research, Statistics and Computing. Univ. of the Basque Country & Univ. of Zaragoza (Spain)

PhD in Robotics and AI. Univ. of Zaragoza (Spain)

Research stay at Belongie Lab. Univ. of Copenhagen (Denmark)

Robotics Expert. BSH Home appliances (Spain)

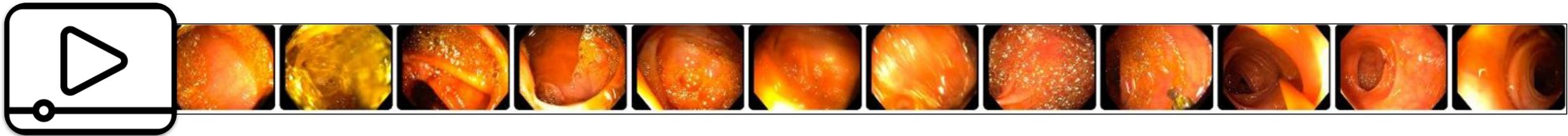
Gesture recognition for Human-Robot(AUV) Interaction



Aiming to command UAV movement with natural gestures. Record, label and release a dataset for research.

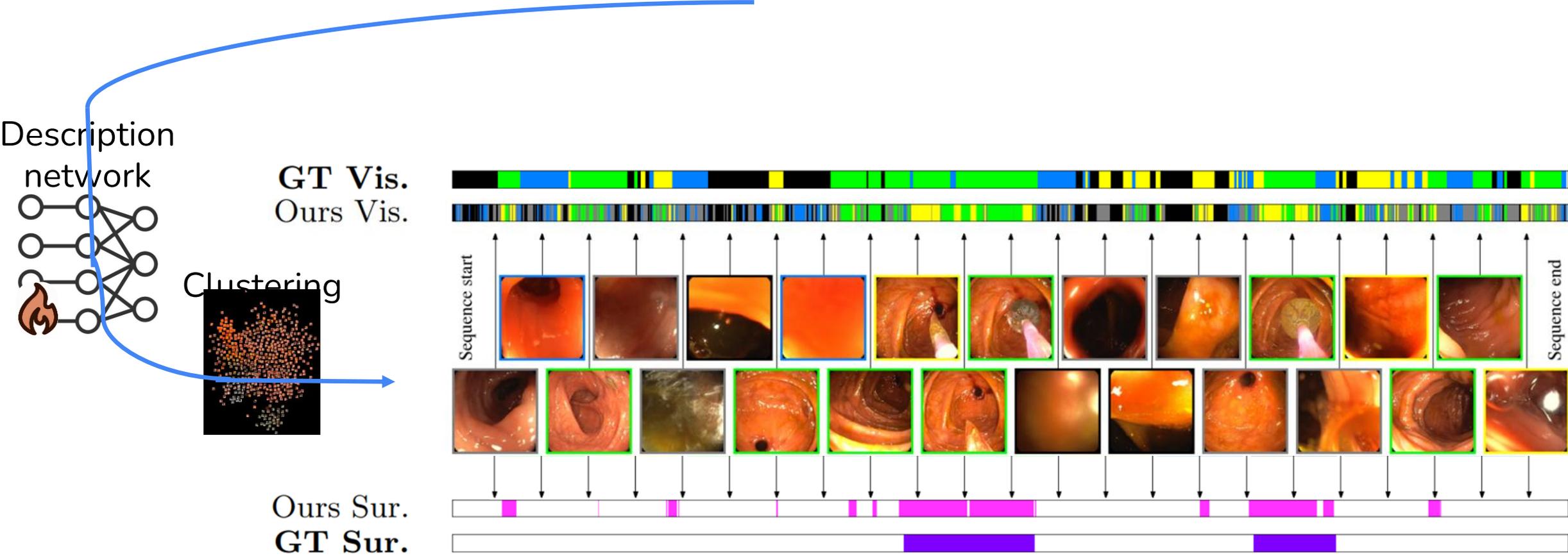
EndoMapper: Real-time mapping from endoscopic video

Dataset of Endoscopy Videos



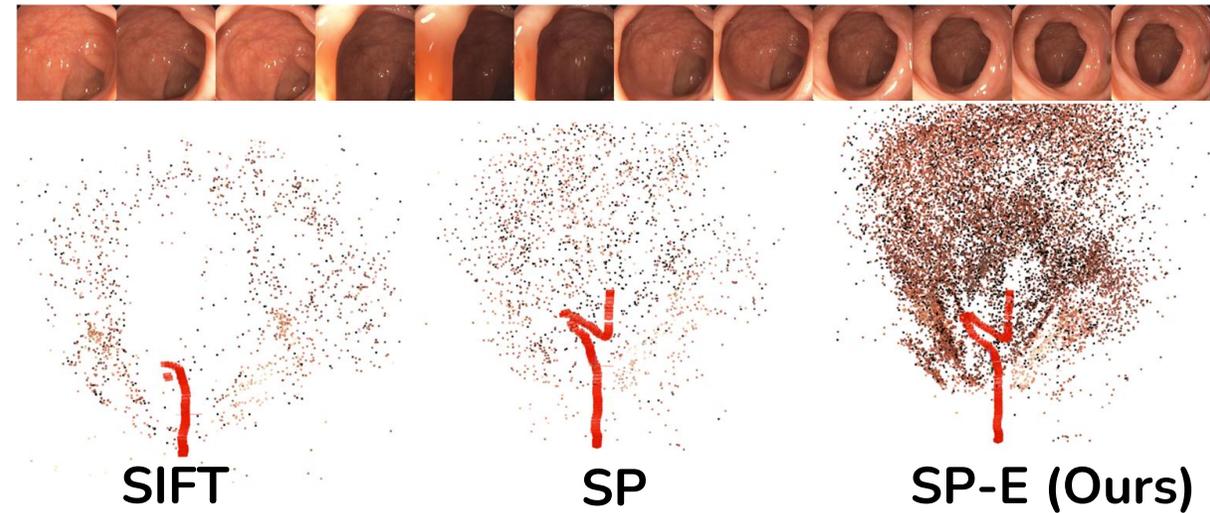
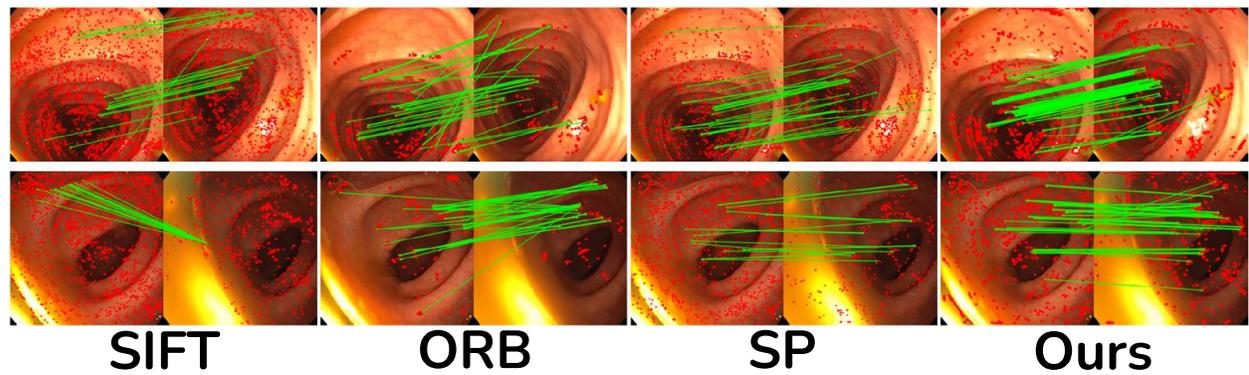
Over 100 full videos of regular practice recordings of endoscopies. I helped curating and labeling.

Summaries of Full Videos



Automatic overview of full videos. Visibility estimation and surgical action detection.

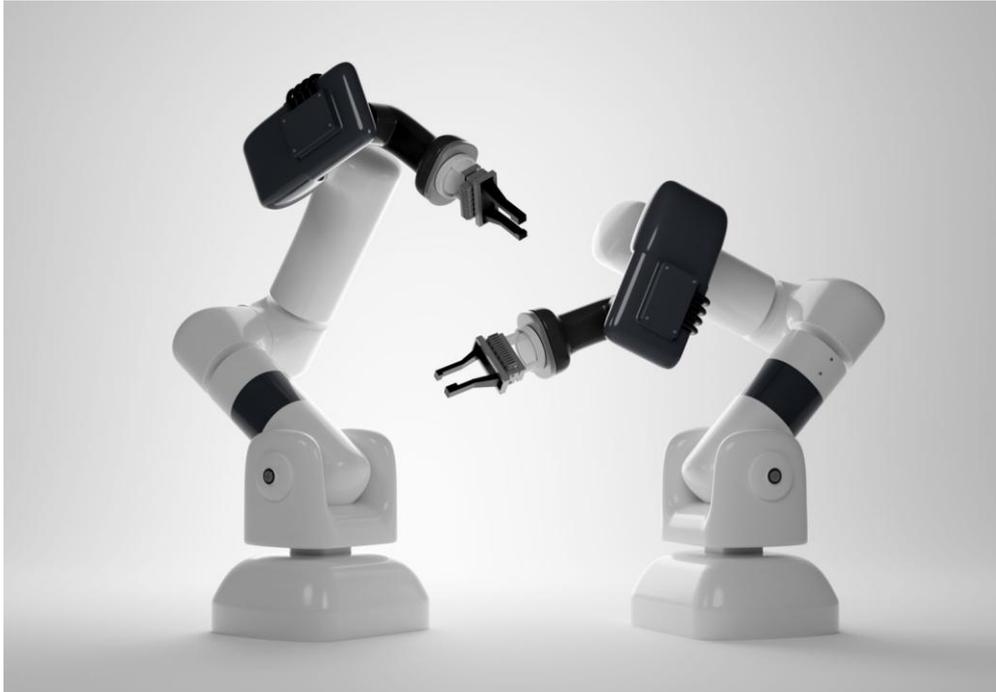
Improved Keypoint Detection



Specular reflection avoidance to improve match stability and geometry estimation.

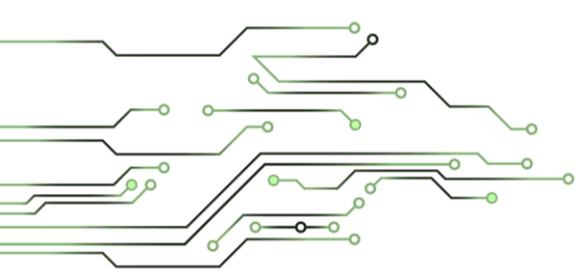
Further adapted to 3D SfM. Denser reconstructions that cover longer video sections.

BSH: Robotics for domestic environments



Robotics manipulation challenges at home (e.g. folding laundry, pouring a glass of water, etc.).

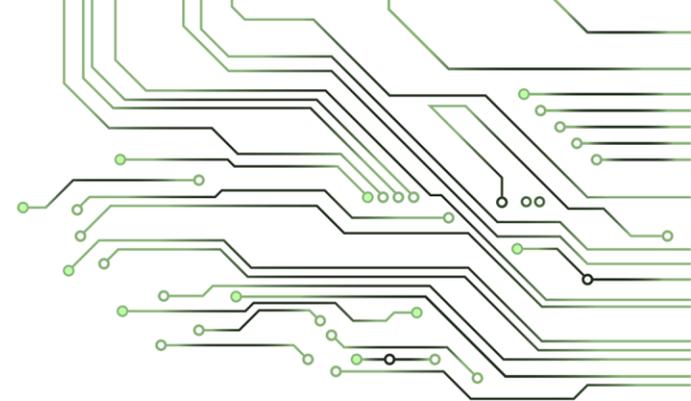
Oskars Vismānis



ELEKTRONIKAS UN
DATORZINĀTŅU
INSTITŪTS



INSTITUTE OF
ELECTRONICS AND
COMPUTER SCIENCE



Reusable robot skills for open-set task execution

Oskars Vismanis

Researcher

ROMANDIC Winter School 2026

Open-set task challenges

- Dynamic and unstructured environments require highly autonomous systems
- Parameterized control and use of foundation models enable adaptability
- Each present different drawbacks
 - Foundation models – reliability and safety
 - Parameterized control – long-horizon tasks

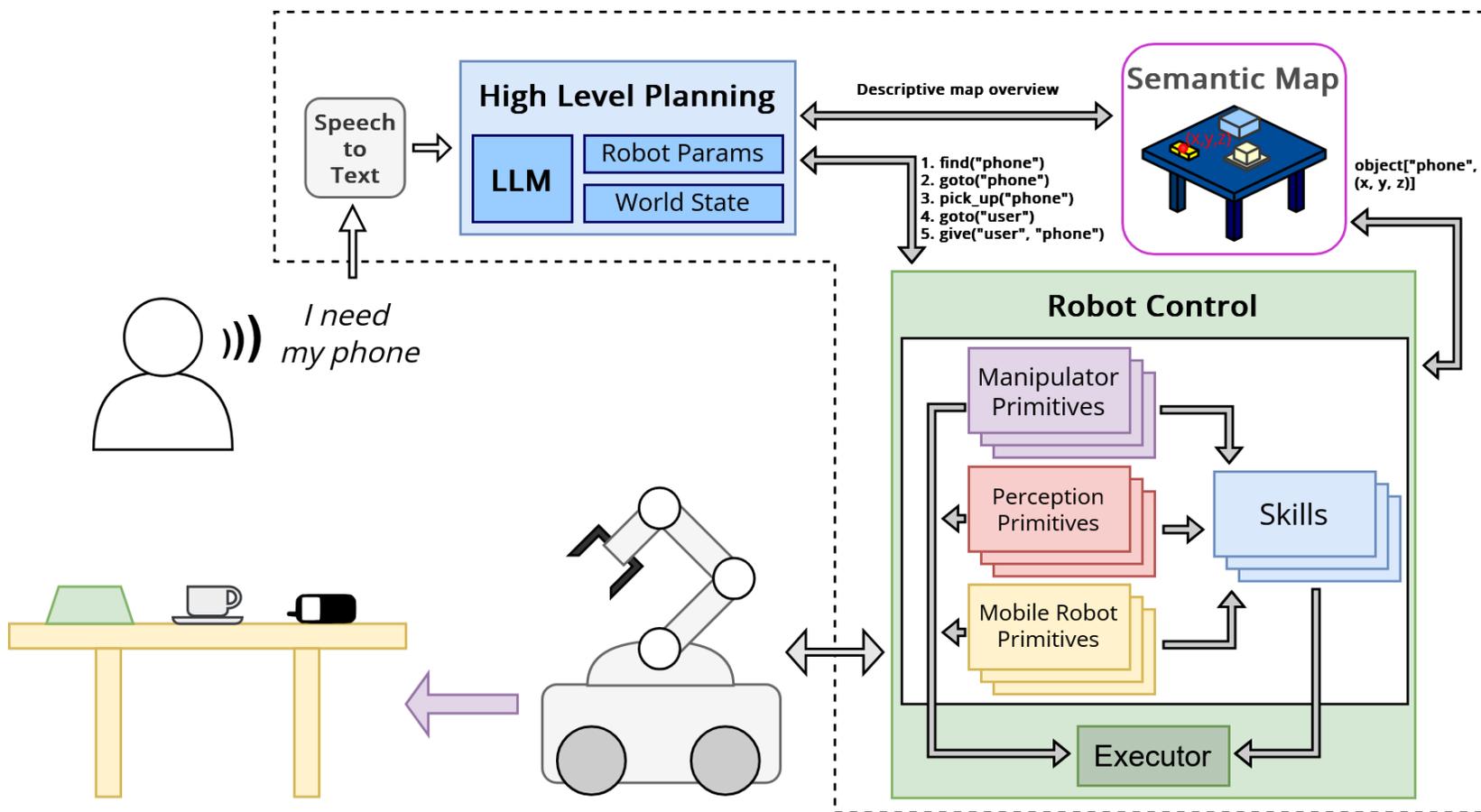


Reusable robot skills

- Small-scope functions – can be evaluated; reliable
- Long-horizon tasks enabled with sequencing/planning techniques
- Can be hardware agnostic

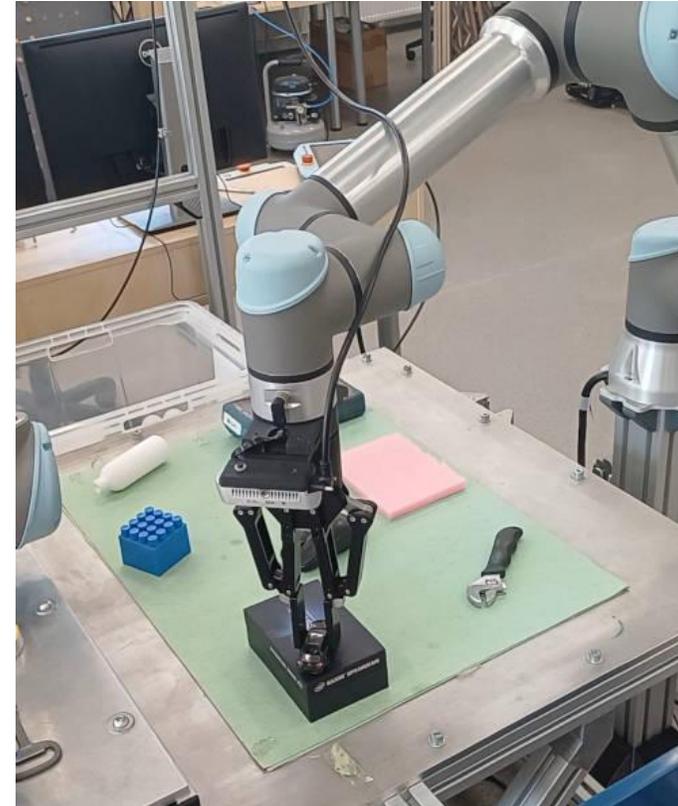


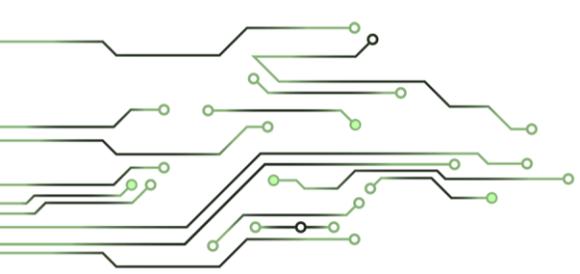
NLP-Based open-set mobile manipulation



Application domains

- Industrial
 - Interactive pick-and-place
- Domestic
 - Robot assistant
- Outdoor
 - Inspection

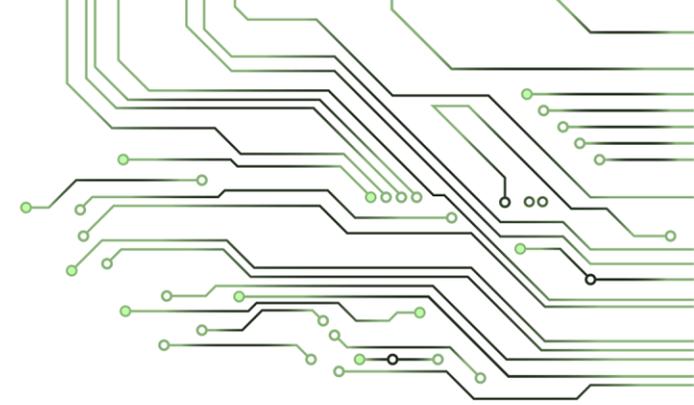




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INSTITUTE OF
ELECTRONICS AND
COMPUTER SCIENCE



ChipsJŪ

Thank you!

Oskars Vismanis

oskars.vismanis@edi.lv

robogroup.edi.lv / www.edi.lv

Peter Nimac

Unfolding the challenge: Robotic Solution to Autonomously Unfold Crumpled Garments

Peter Nimac



ROMANDIC



Mednarodna Jožef Stefan
podiplomska šola International
Jožefa Stefana Postgraduate School

Supervisor: Andrej Gams

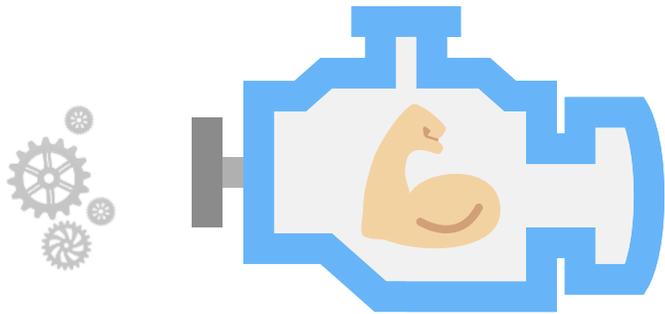
Affiliation(s):

E1 – Department of Automatics, Biocybernetics and Robotics, Jožef Stefan Institute,
Ljubljana, Slovenia

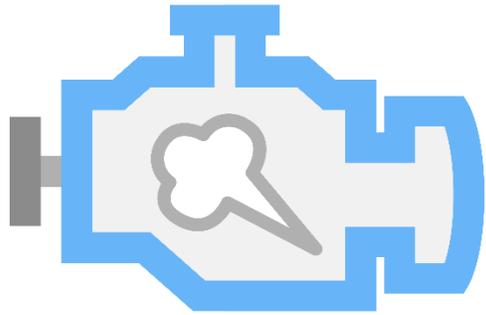
Jožef Stefan International Postgraduate School, Ljubljana, Slovenia



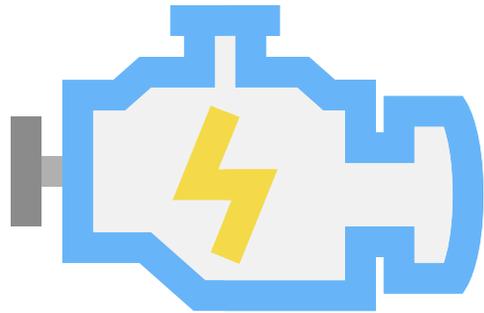
~4000 B.C.



~1800 A.D.



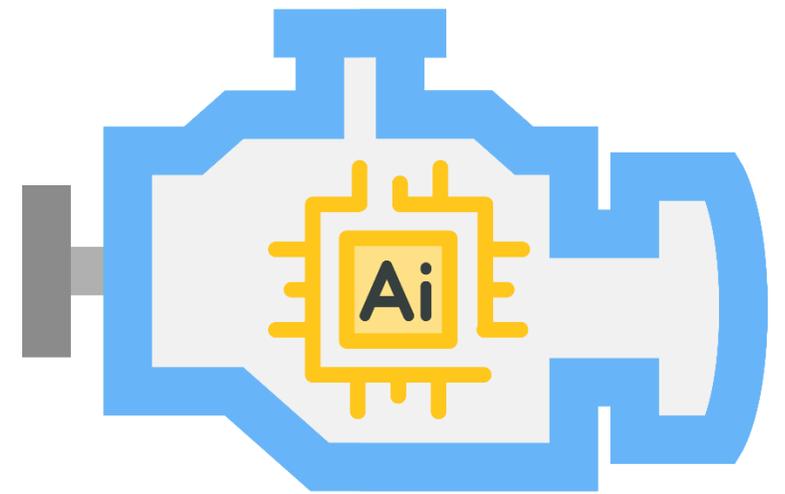
20th Century A.D.



21st Century A.D. and Onwards



21st Century A.D. and Onwards



2024 A.D. – Yokohama, present day

ViCOS
visual cognitive
systems lab

FRI
UNIVERSITY OF LJUBLJANA
Faculty of Computer
and Information Science
Jožef Stefan Institute,
Ljubljana, Slovenia

Team Ljubljana

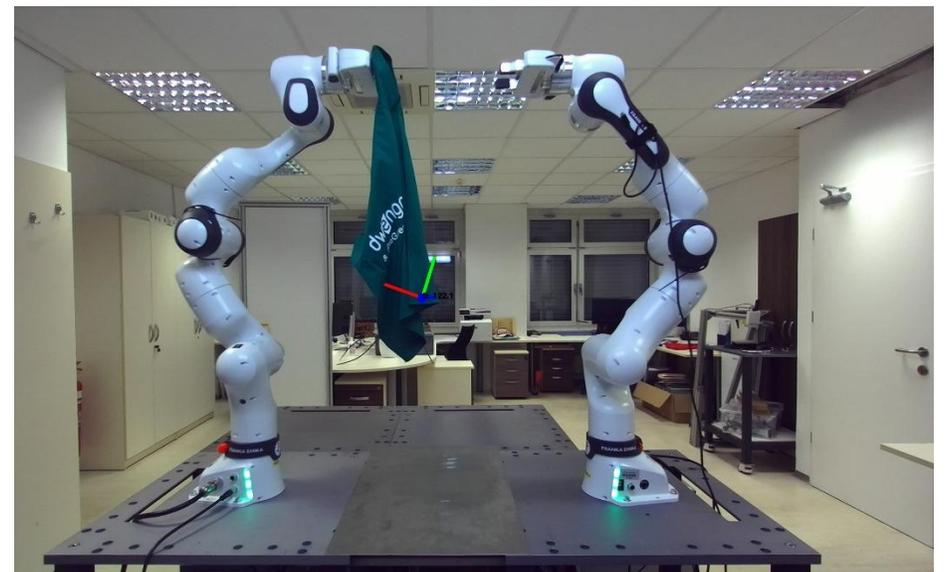
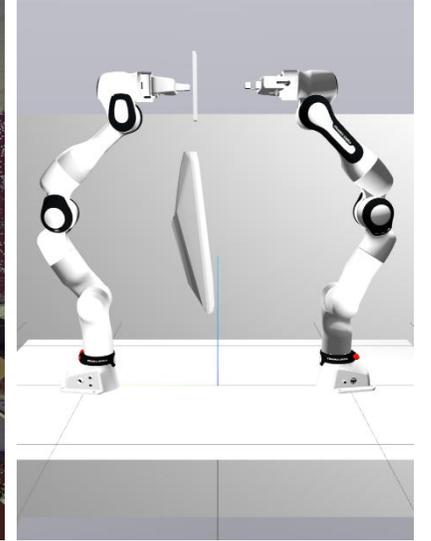
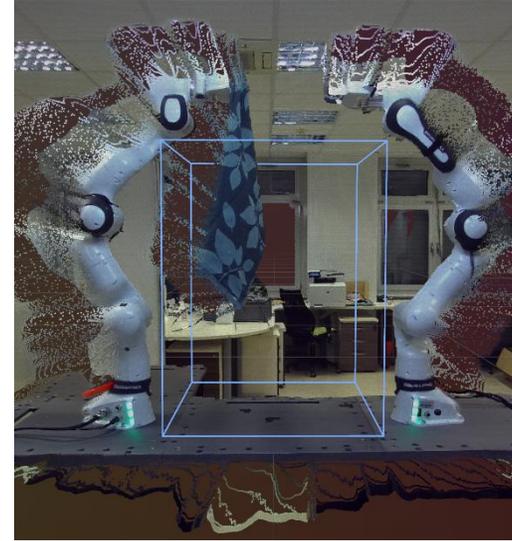
- Domen Tabernik
- Andrej Gams
- Peter Nimac
- Matej Urbas
- Jon Muhovič
- Danijel Skočaj
- Matija Mavsar

- Cloth unfolding competition at International Conference on Robotics & Automation (ICRA)
- ✓ Standardised **dual-arm** robot setup
- ✓ Training set of **~500 images**
- ✓ 11 competing **state-of-the-art** approaches



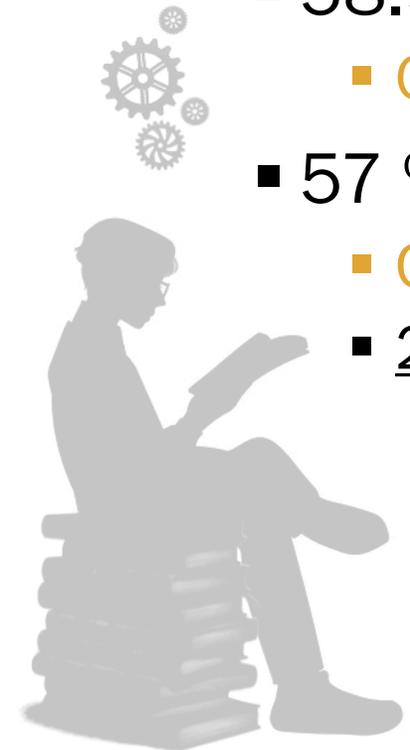
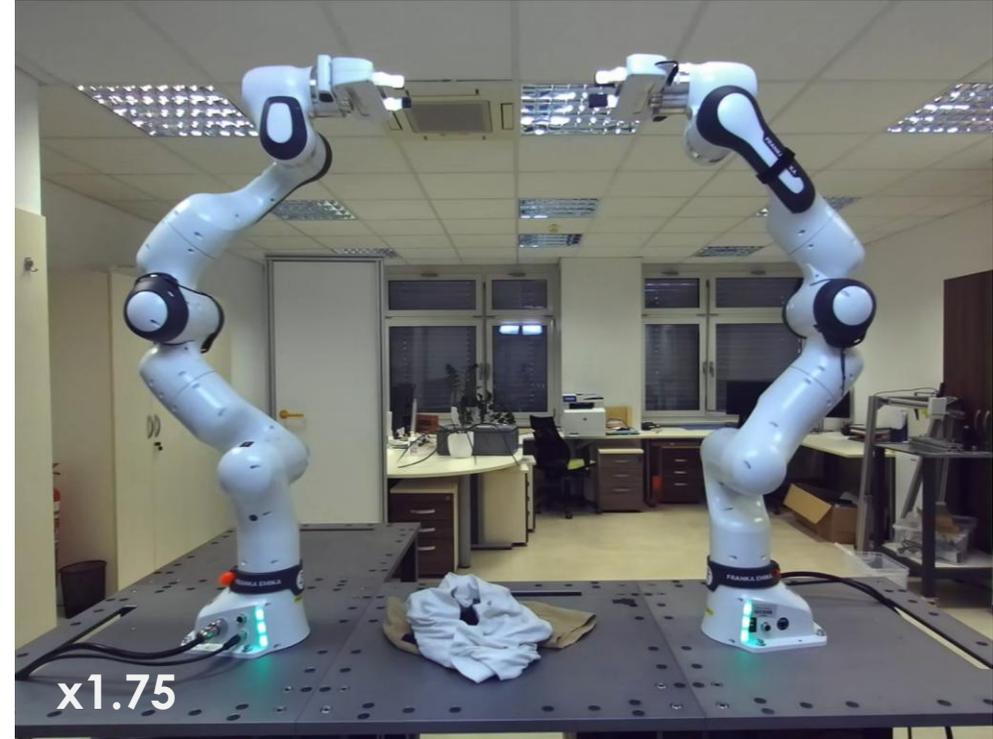
AI Driven Robotic Solution

- Dual-arm robotic configuration
 - Franka Emika FR3 with 7 joints
- Zed 2i stereo depth camera
- Image model - **CeDiRNet-6DOF**
- Digital twin
 - Collision avoidance
 - Path planning



Challenge Unfolded

- 16 different textiles
- 72.5 % grasp success rate
- 58.9 % unfolding coverage rate
 - Own testing results
- 57 % average coverage rate
 - Competition results
 - 2nd best result



THANK YOU!

Contact: peter.nimac@ijs.si

Colleagues:

Jan Jeričević - JSI

Domen Tabernik – FRI, UL



ROMANDIC

Petr Vanc

Vision-based Monitoring & Branching for Robot Skills

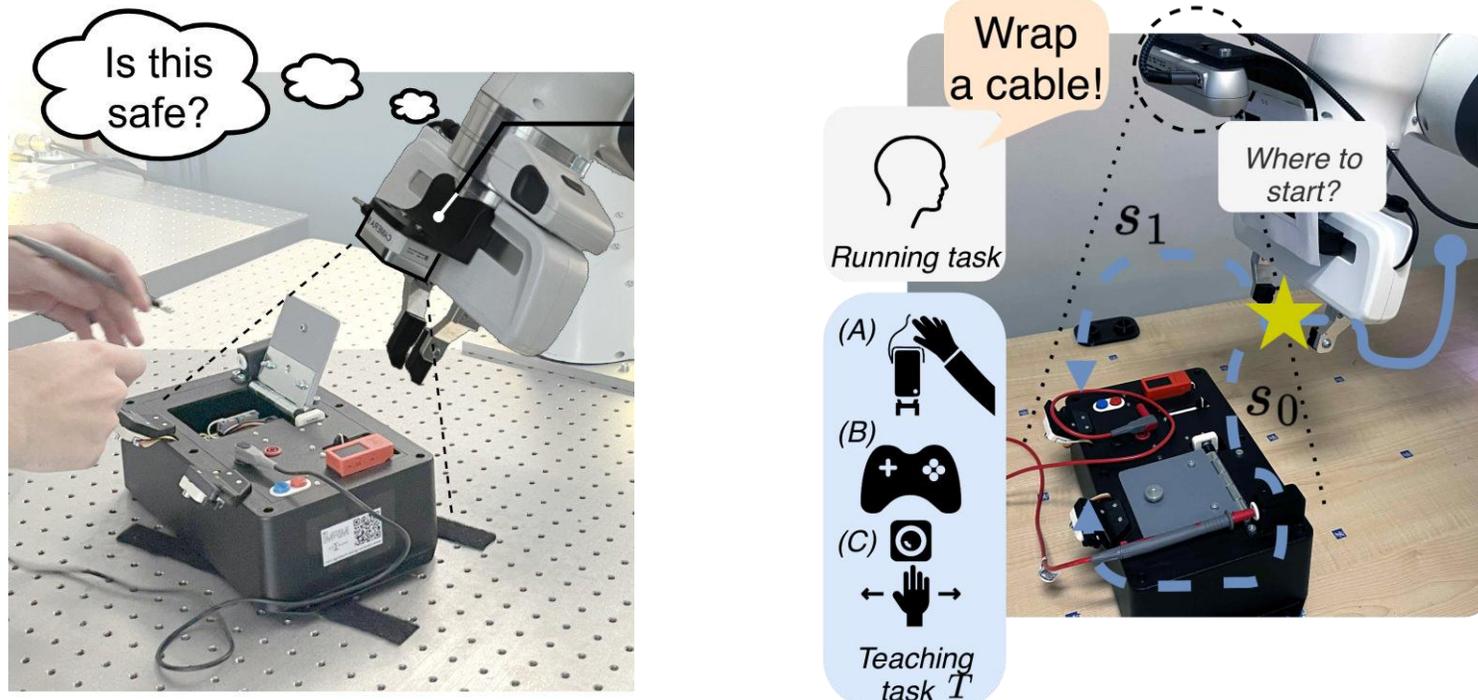
Petr Vanc
PhD student



**CZECH INSTITUTE
OF INFORMATICS
ROBOTICS AND
CYBERNETICS
CTU IN PRAGUE**

Interactive Robot Teaching: Monitoring and Adapting Demonstrations with Vision

- Programming by Demonstration (PbD) is intuitive, but brittle when state of the environment changes
- Problems:
 - Detect when execution becomes unsafe or not familiar
 - Adapt by switching to appropriate known variant or ask for a new one



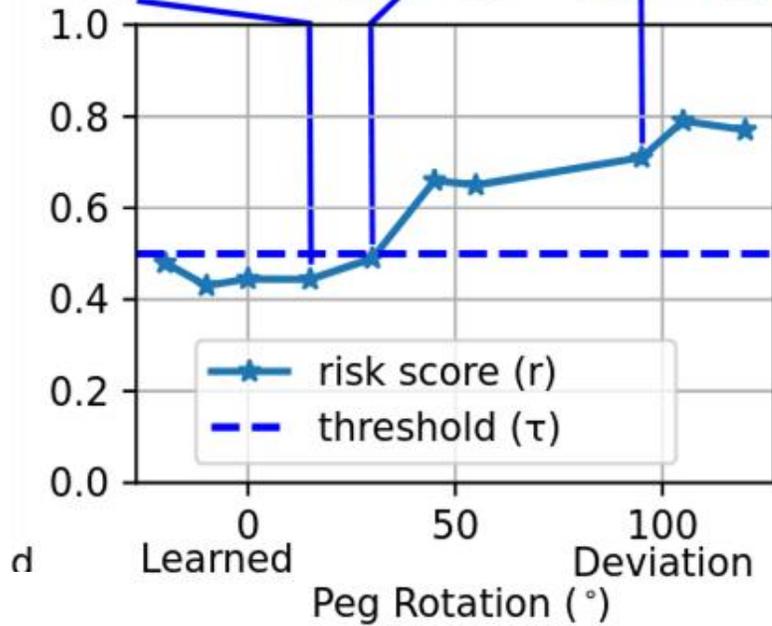
ILeSiA: Interactive Learning of Robot Situational Awareness from Camera Input

Research question:

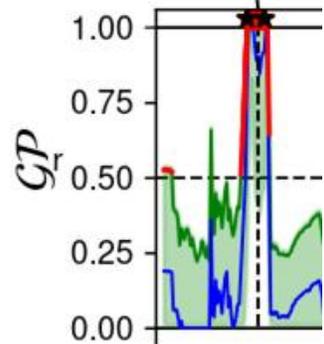
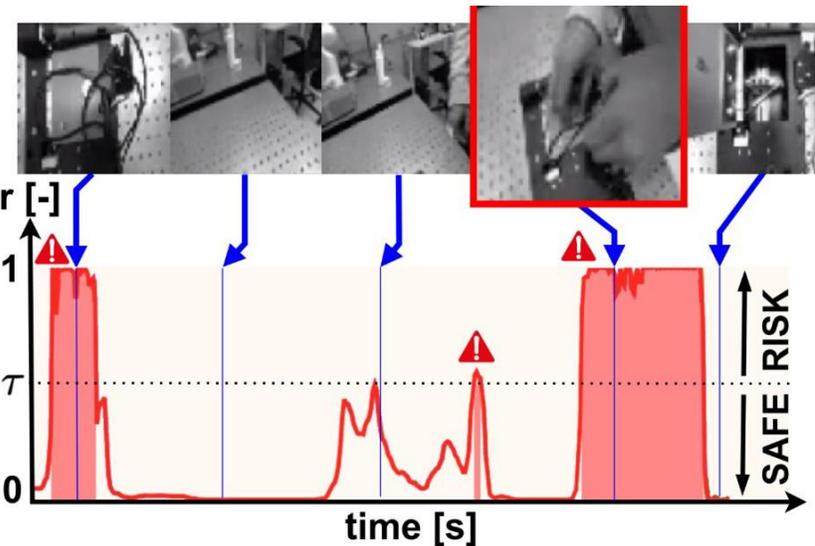
Can a robot pause before failure using only camera and small human input?

Method:

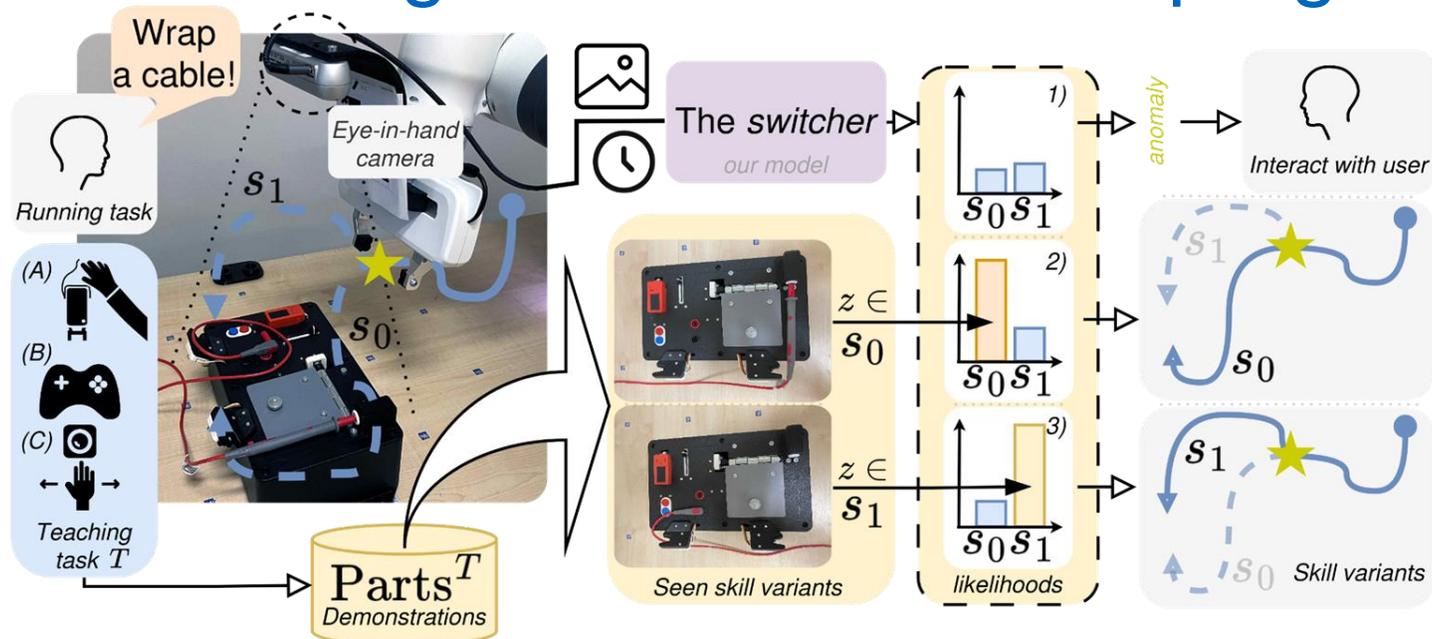
- Compress (embed) video
- Gaussian Process risk estimator (uncertainty as proxy for out-of-distribution)



$$r = \text{clip}(\mu^* + \sigma^*)$$



Vision-based branching for interactive skill programming



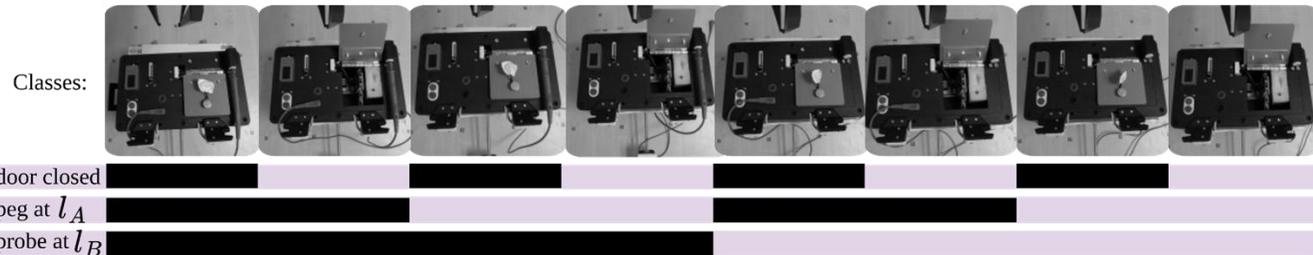
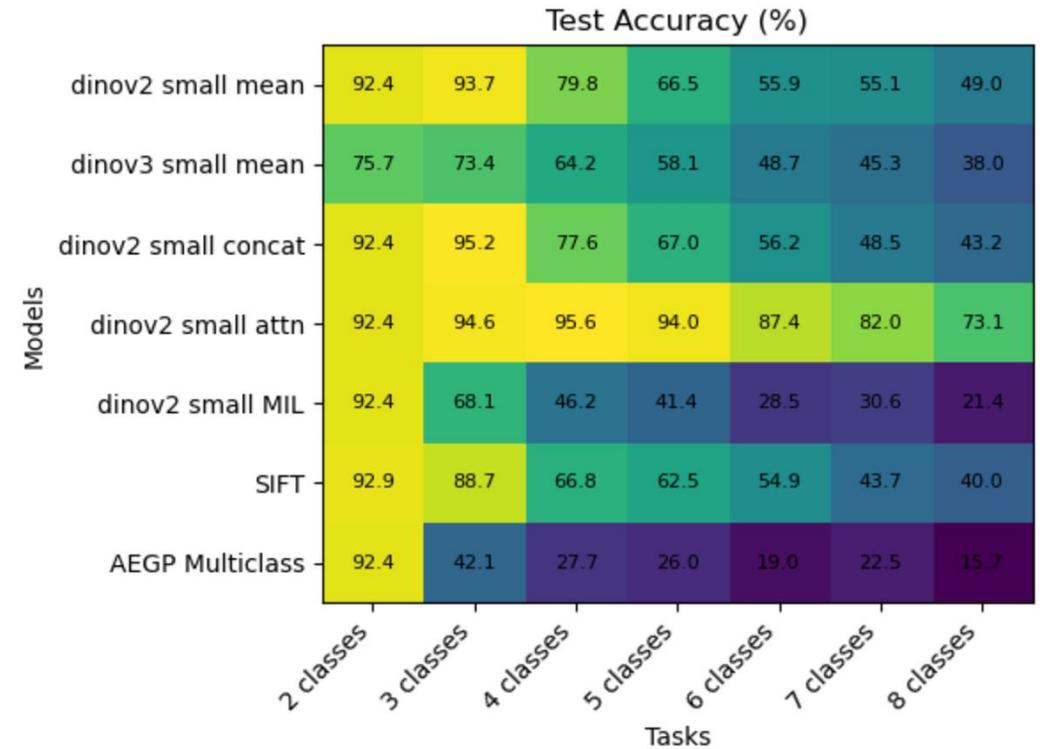
- Problem: one demonstration \neq one task
 - We need conditional skills (task-graph with decision states)
- Method: At each decision state, use eye-in-hand vision to pick a successor skill part or trigger anomaly and ask user for a new demo
- Teaching via kinesthetic, joystick, or hand gestures (modality-agnostic)

Conclusion: Safer execution and scalable conditional skills

- Vision enables reliable observation of task context for safety and decision-making at selected points during execution
- Human involvement decreases over time

The robot learns to:

1. Detect unfamiliar situations
2. Request a corrective demonstration
3. Store it as a new skill branch



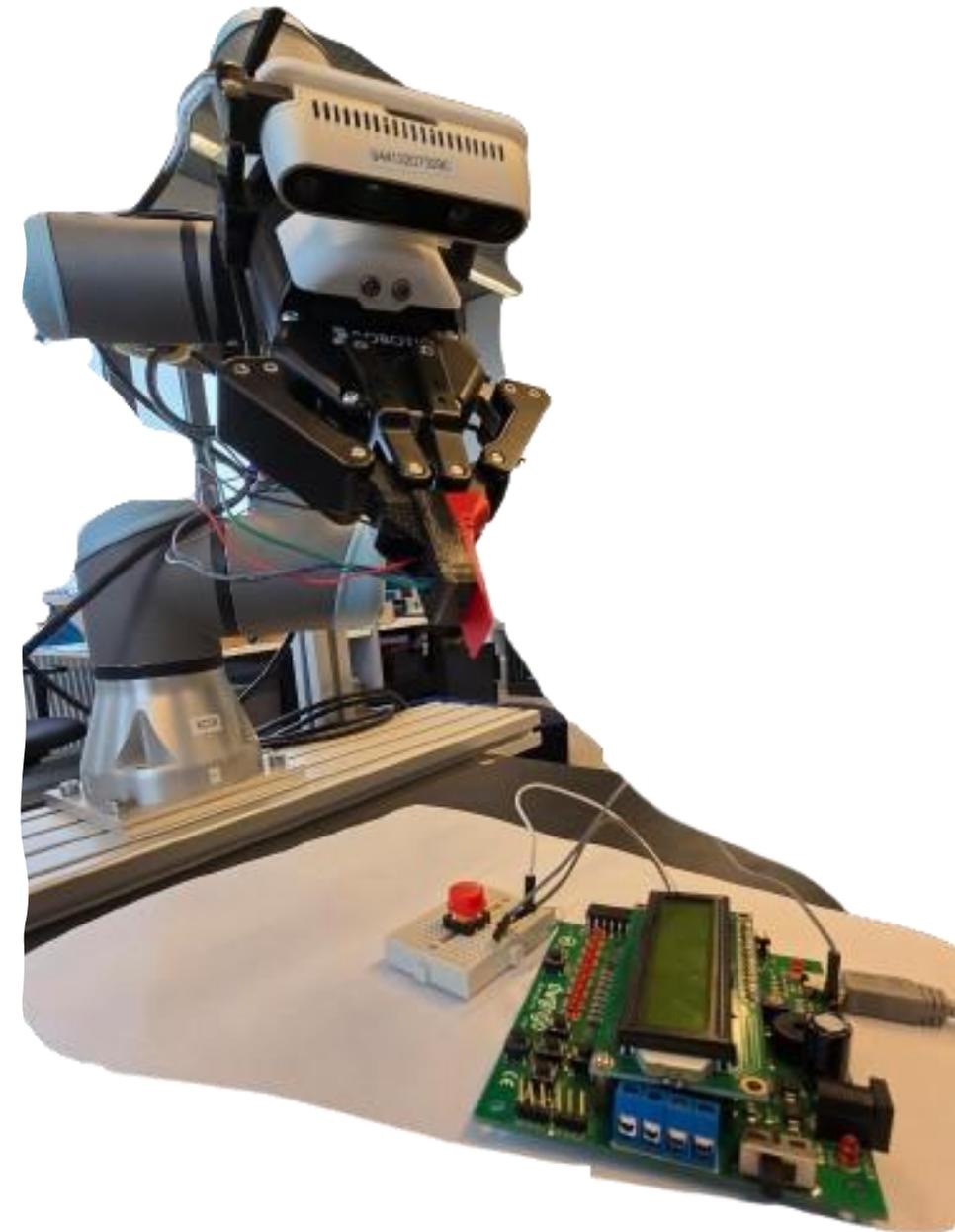
Raman Talwar

INSTRUMENTATION FOR ROBUST ROBOTIC MANIPULATION

Research by Raman Talwar, Remko Proesmans,
Thomas Lips, and Francis wyffels

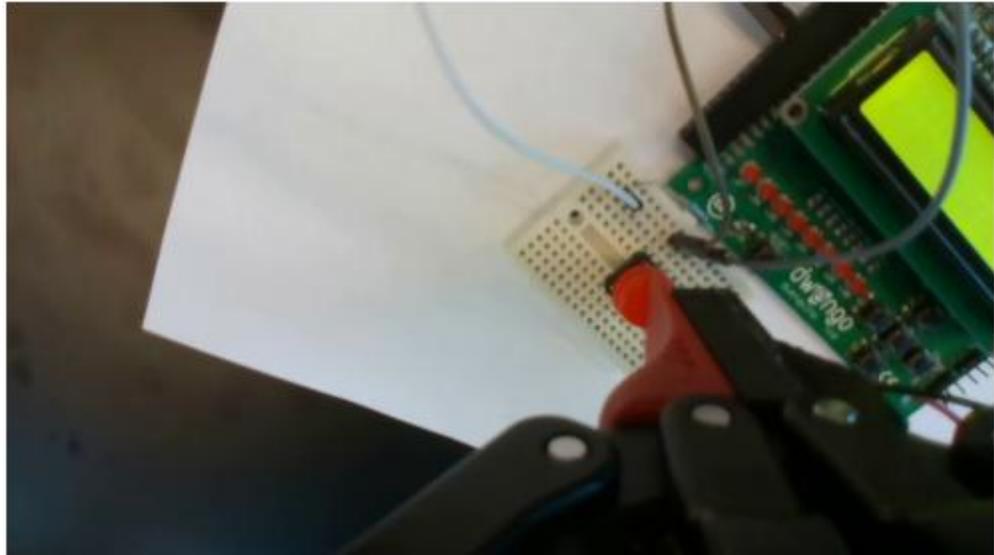
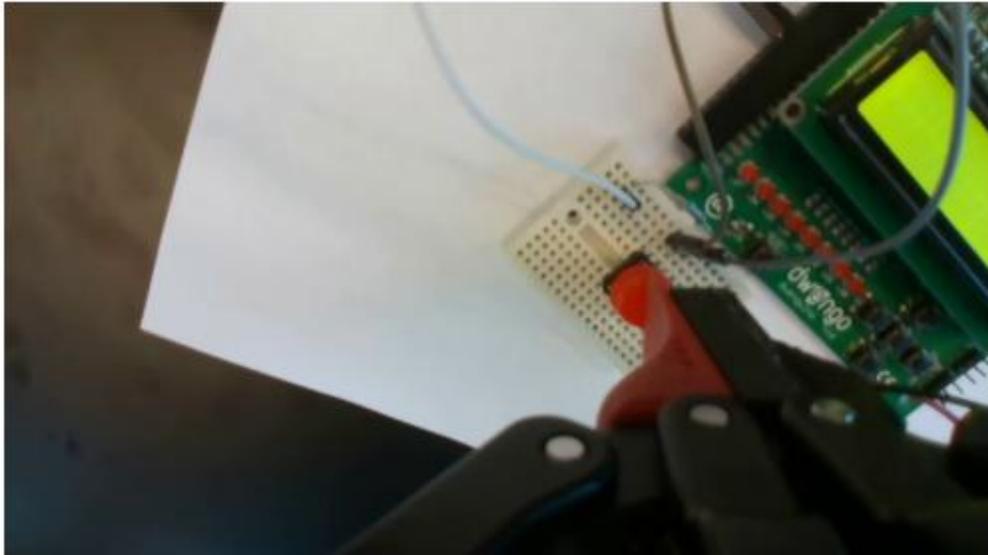
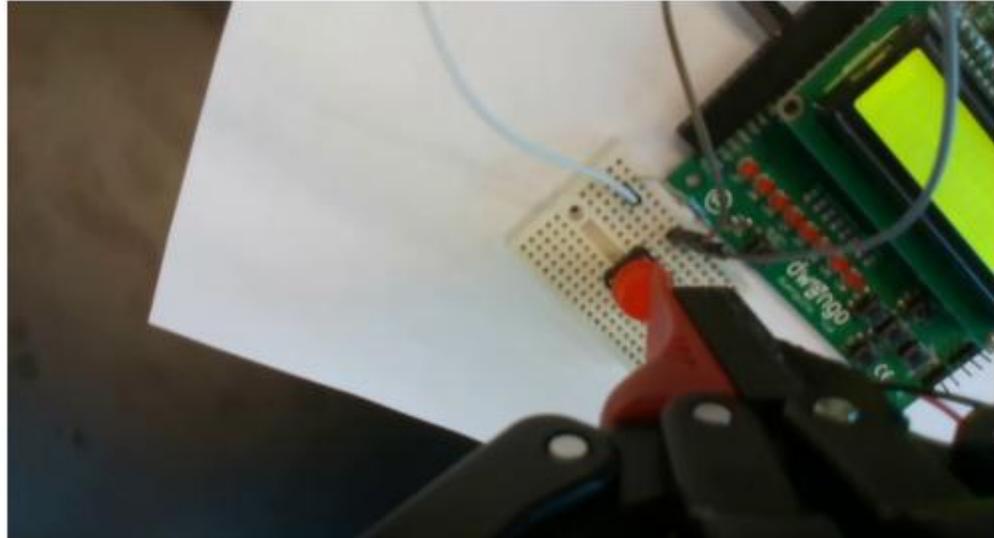
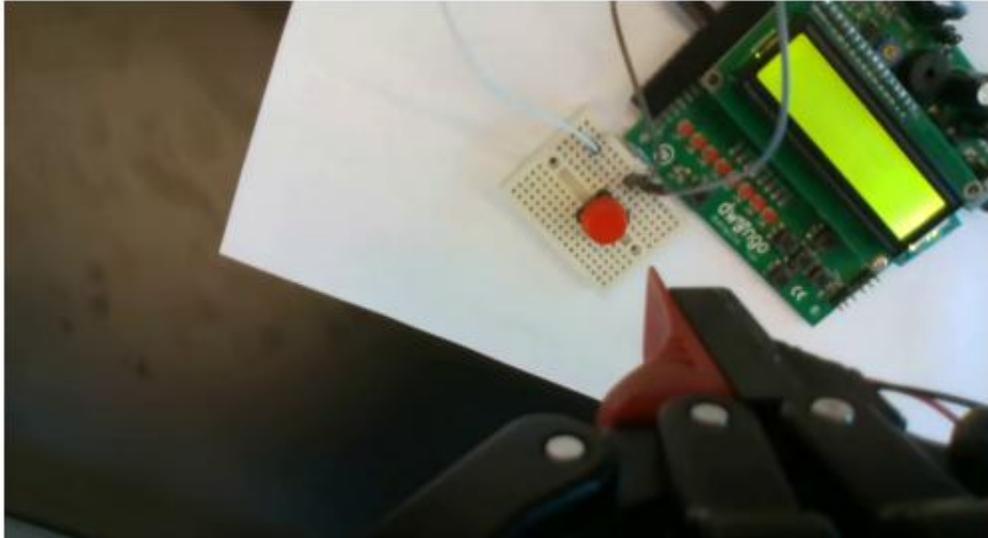


ROMANDIC



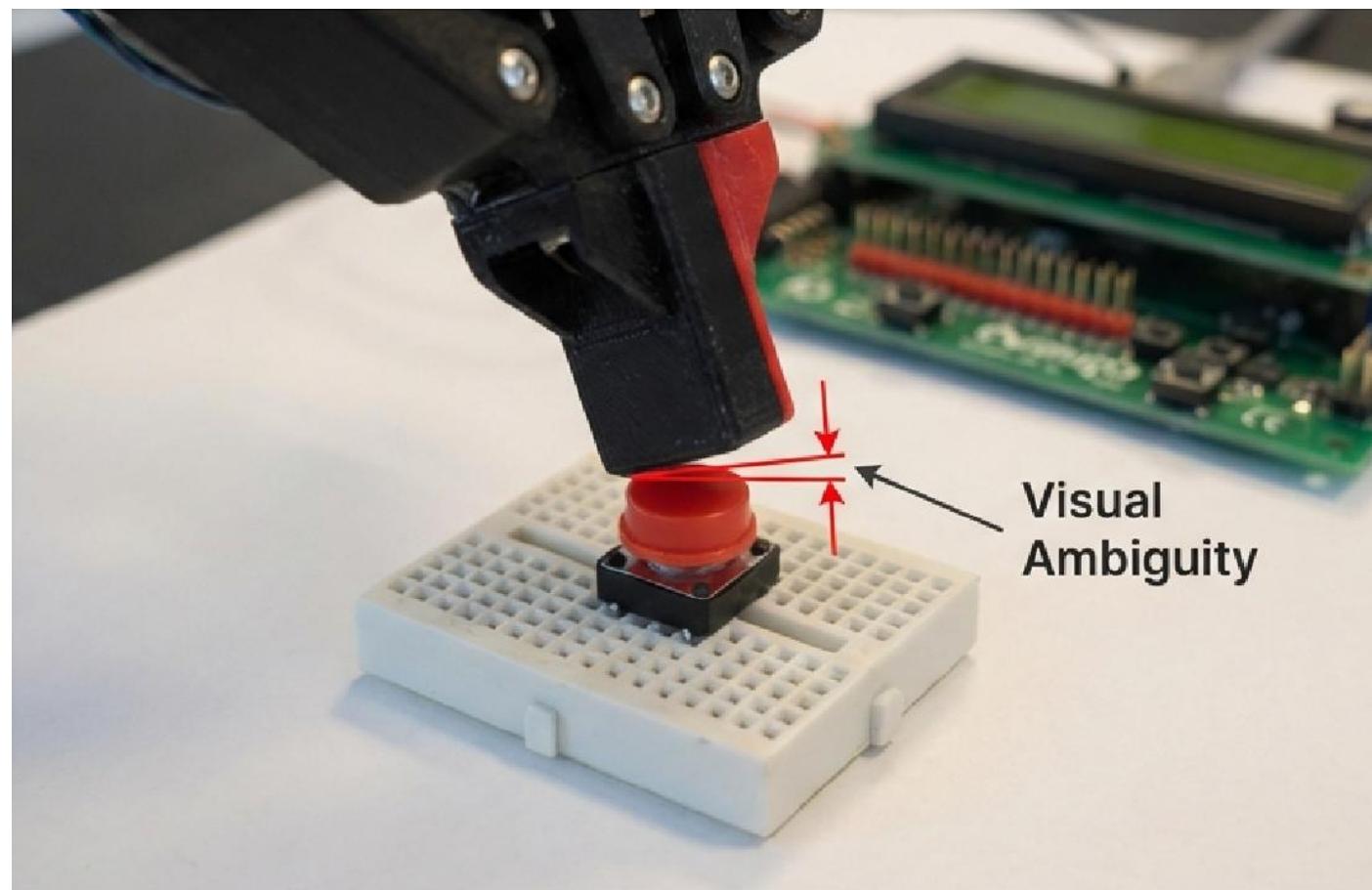
Buttons

Is the button pressed?



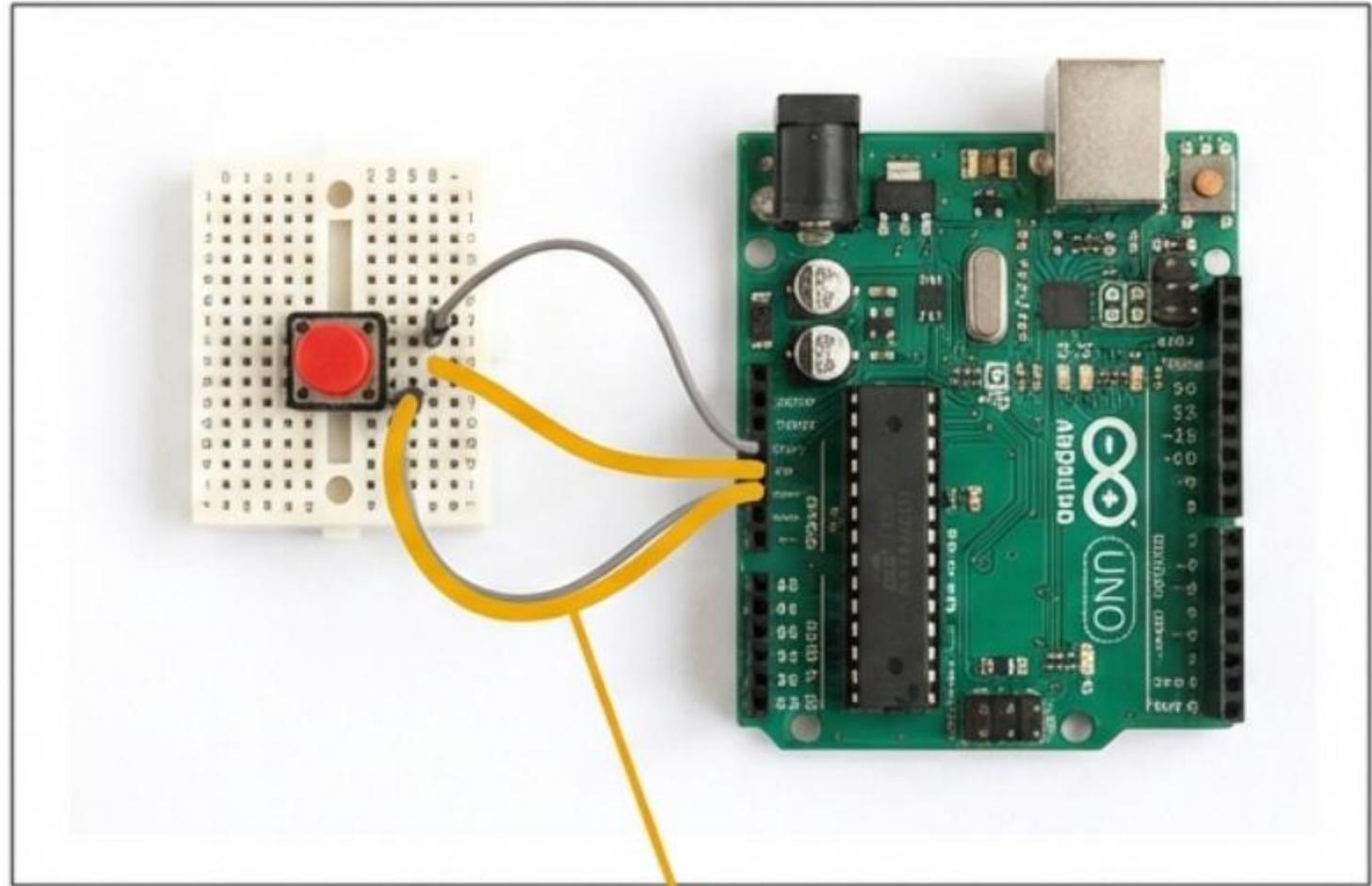
The "Blind" Robot Problem

Vision acts blindly
regarding force and
actuation, leading to
uncertainty in critical
phases of manipulation

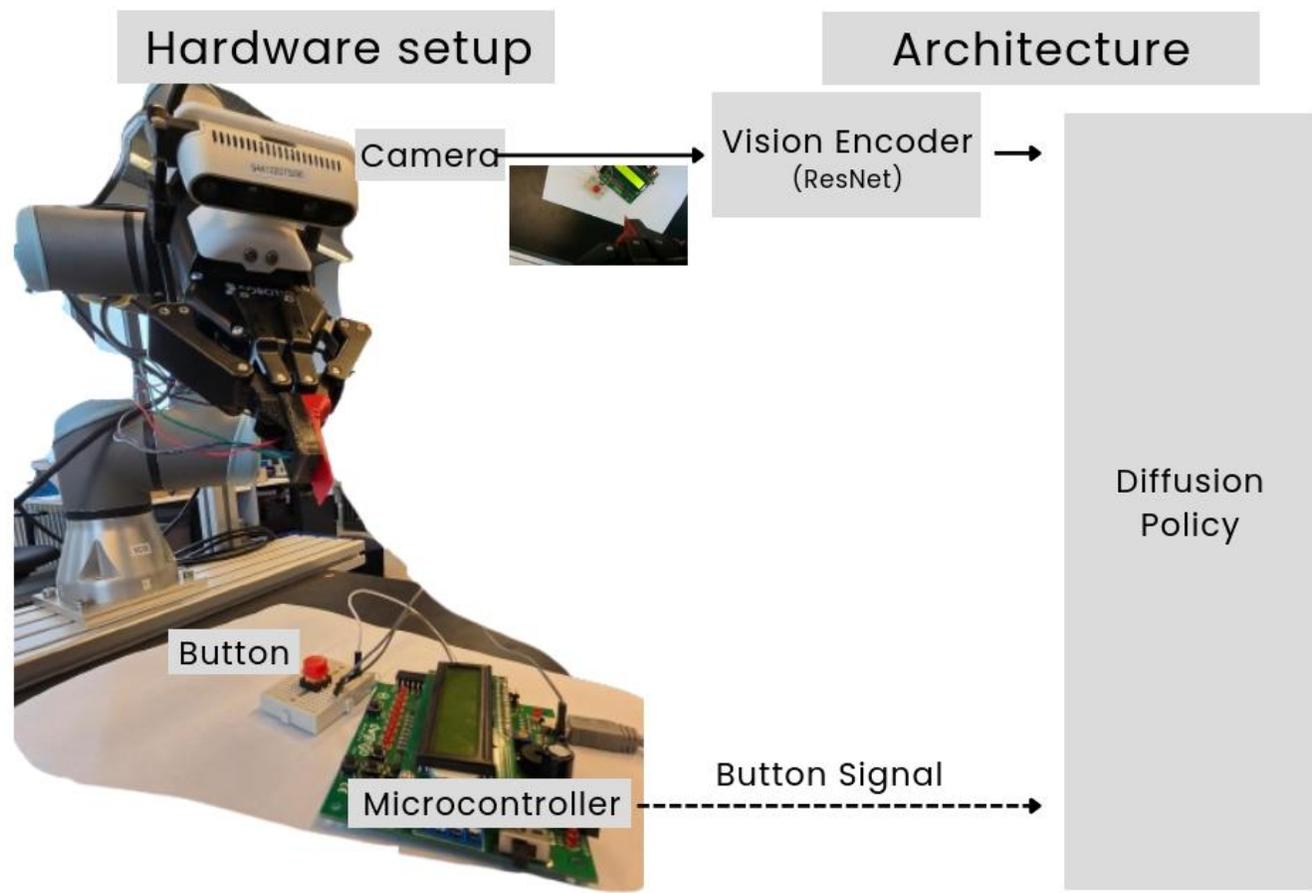


The cheat code: Instrumentation

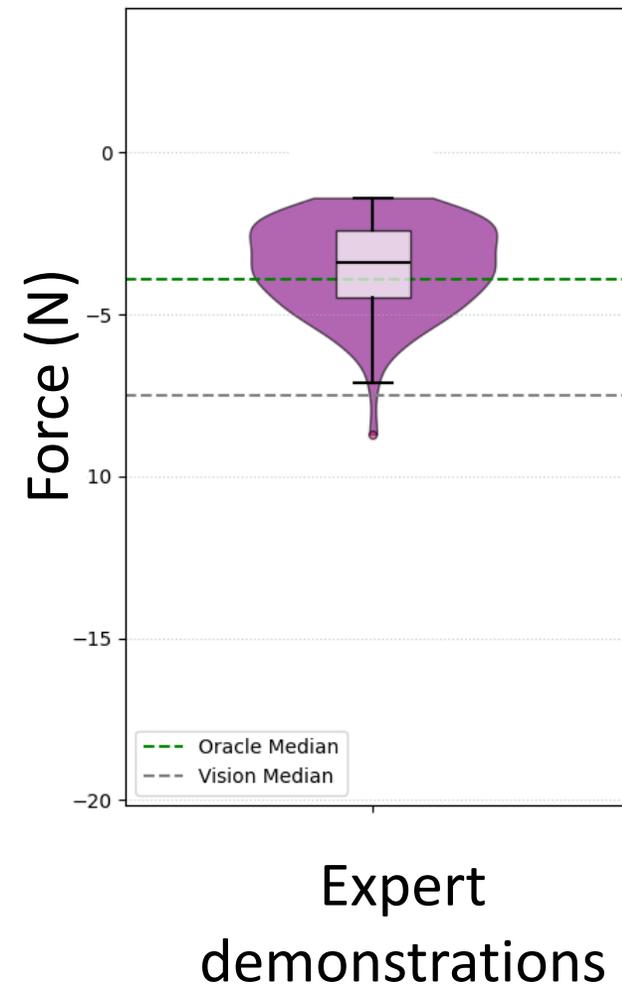
We **instrument** the **environment**, soldering wires to buttons to give the robot **privileged information**.



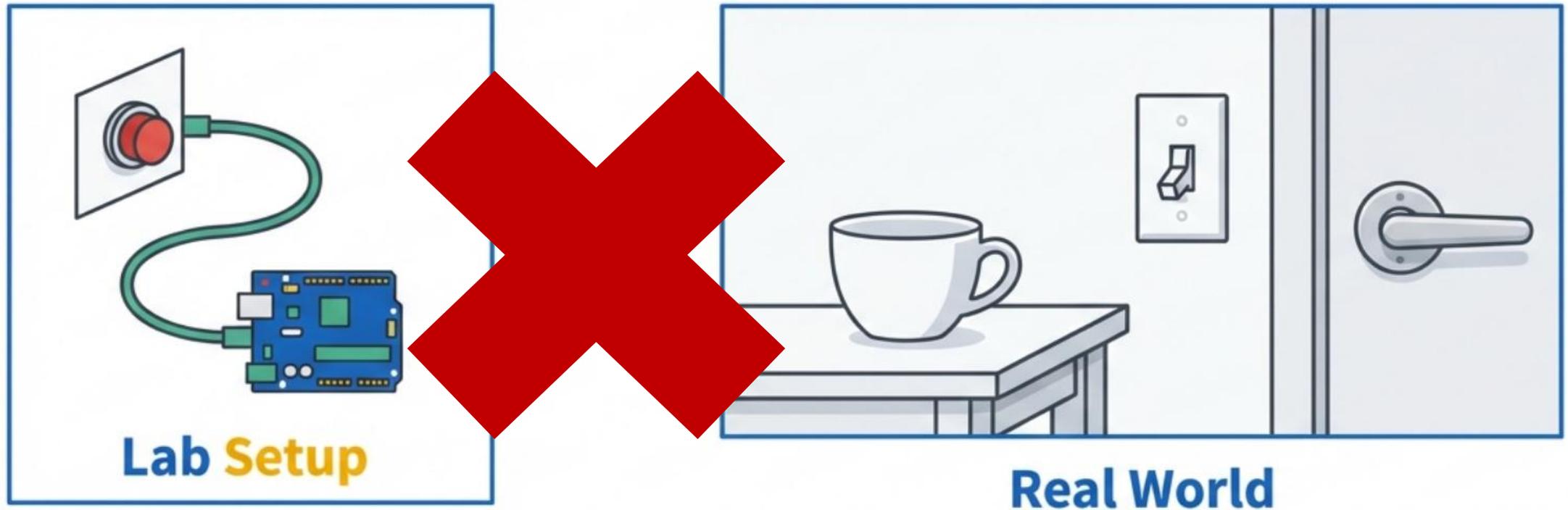
Hard-wired Connection

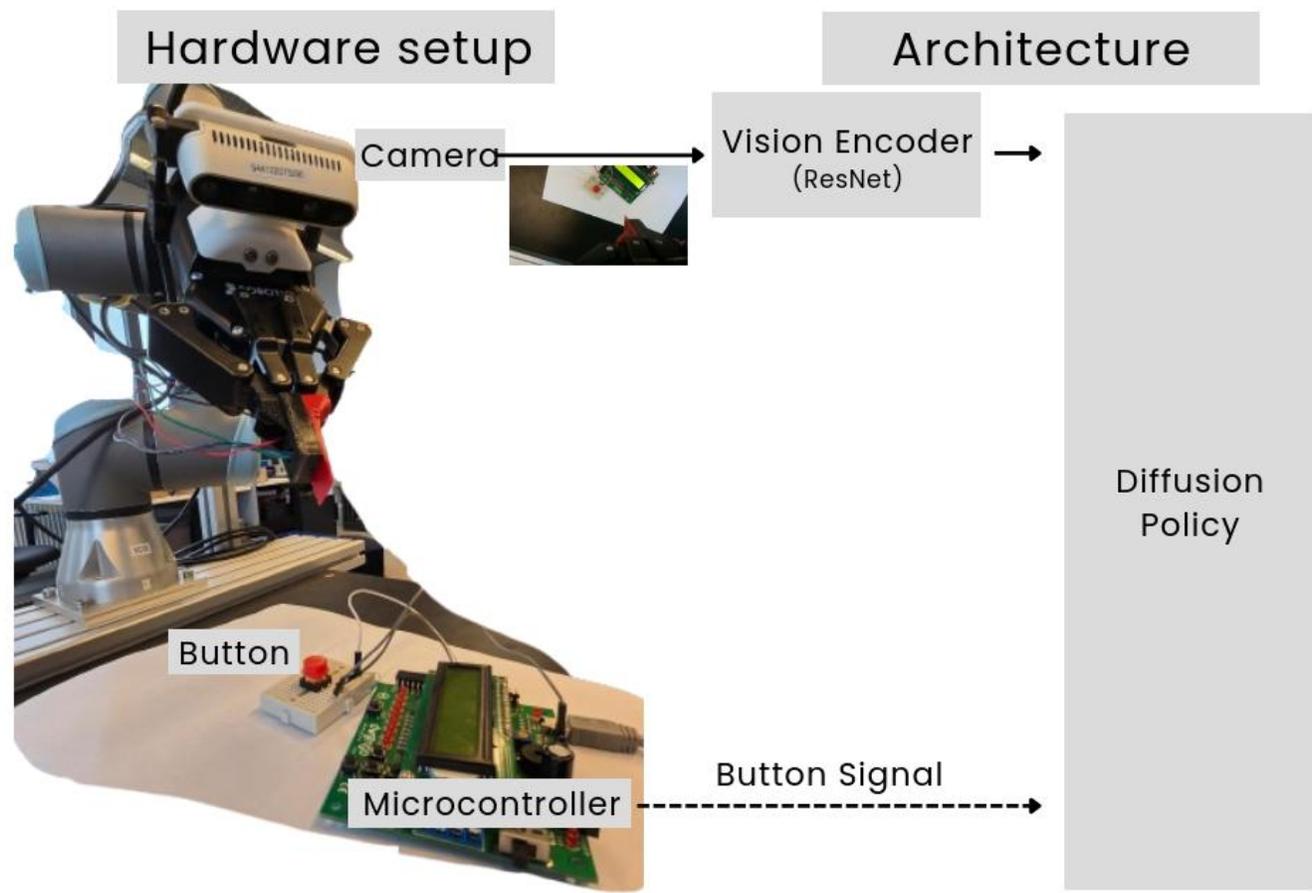


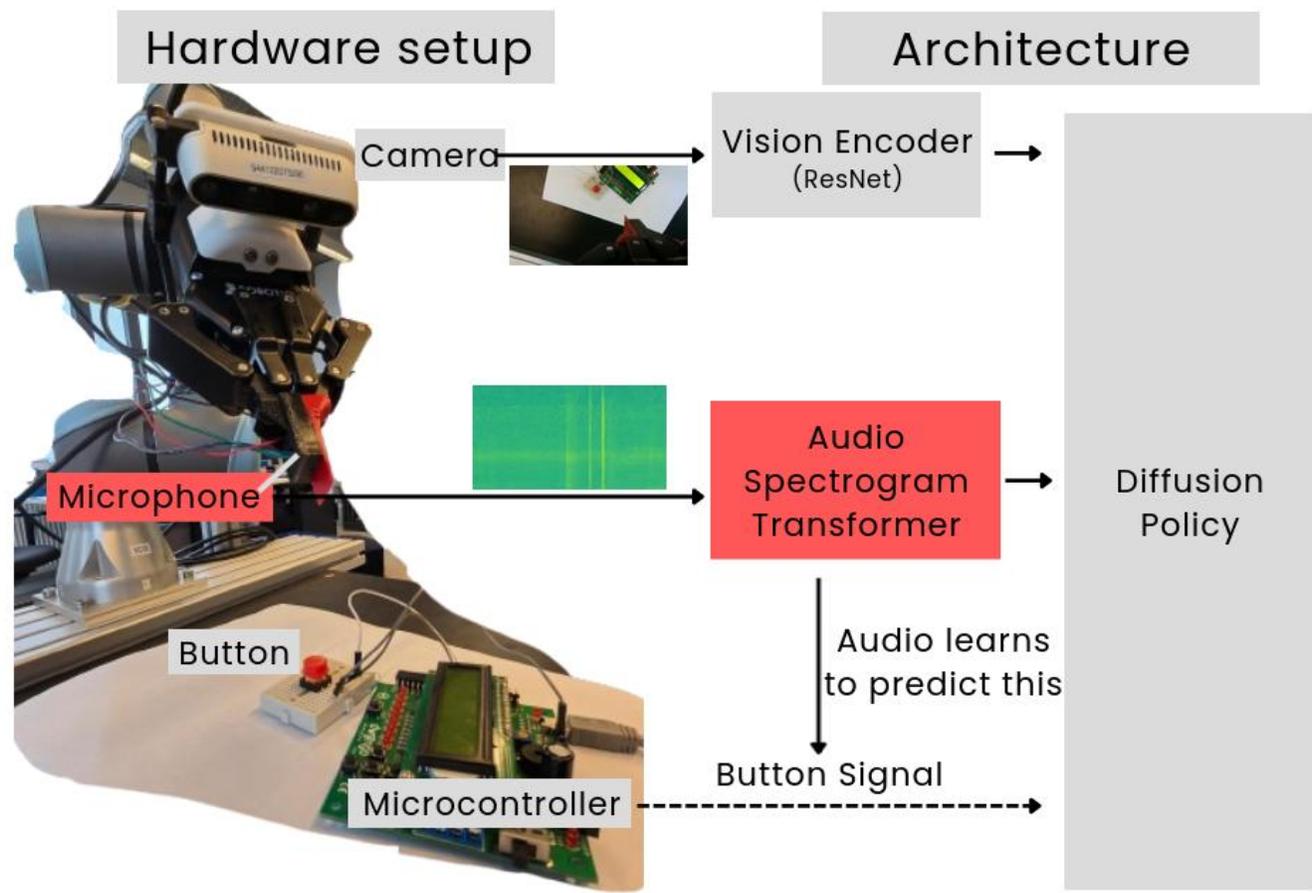
Results

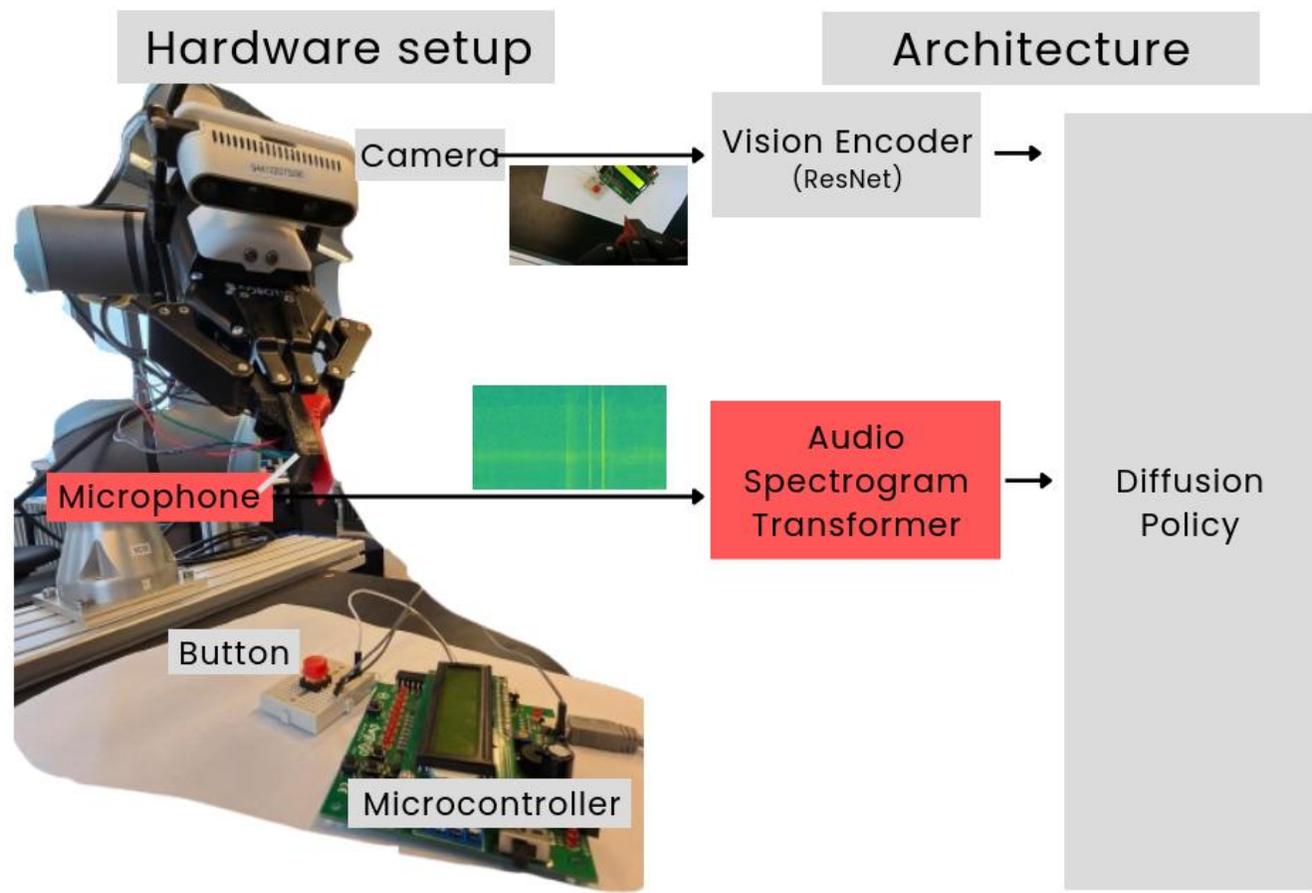


The constraint: We cannot wire the world

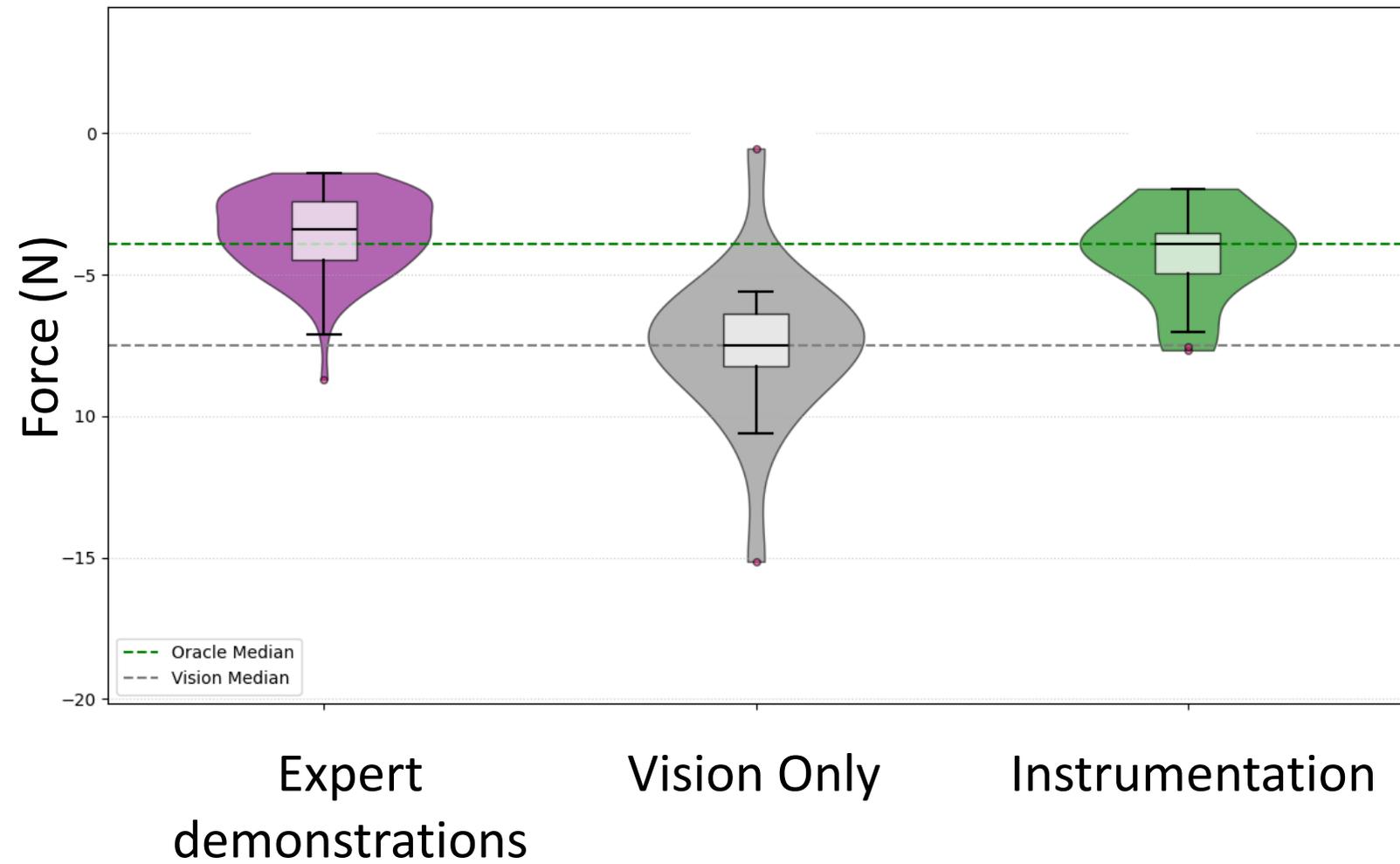




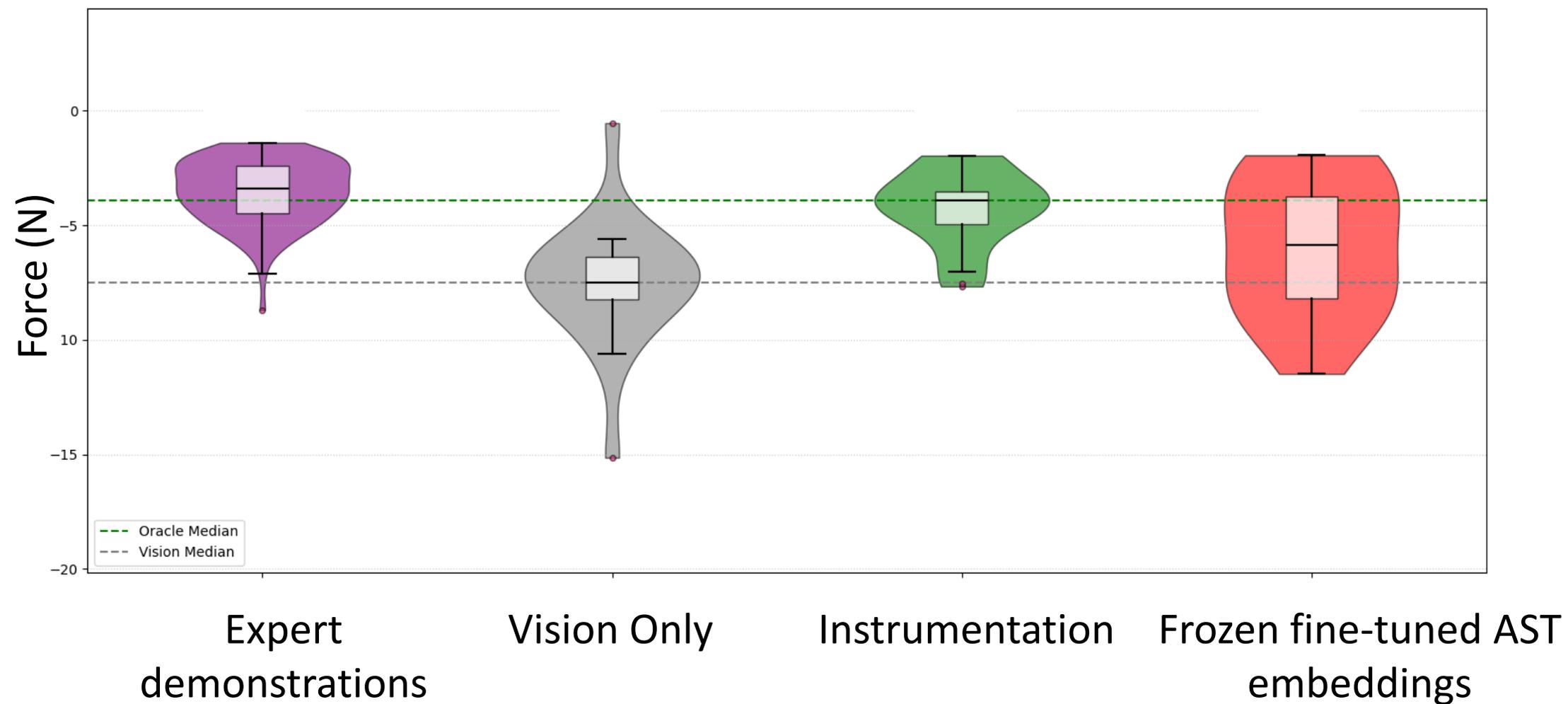




Results



Results



Check out the poster!





FROM WIRES TO WAVES: LEVERAGING INSTRUMENTATION FOR ROBUST ROBOTIC MANIPULATION

Raman Talwar Remko Proesmans Thomas Lips Francis wyffels

Is the button pressed? The "Blind" Robot Problem



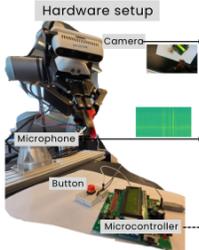
Difficult to tell, isn't it?

- The Challenge:** Learning fine manipulation tasks (like button pressing) with **vision only** is difficult. Cameras **struggle** to detect the precise moment of contact or successful actuation.
- The Cheat Code:** We can wire the button to a microcontroller to get perfect ground truth as **privileged information**, this idea is known as **instrumentation**. This allows **automated data collection** and provides **high-quality expert demonstrations**.
- The Constraint:** We cannot deploy robots into a world where every object is hard-wired. We need to **remove the instrumentation at test time**.

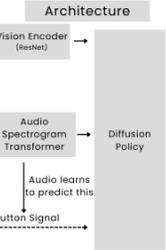
Methodology

We propose using a **gripper-mounted microphone** to **recover** the privileged information typically provided by **instrumentation**. By fine-tuning an **Audio Spectrogram Transformer (AST)**, we enable the system to detect the acoustic signature of a button press.

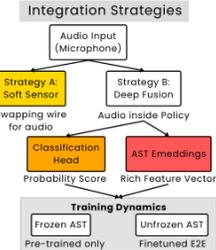
Hardware setup



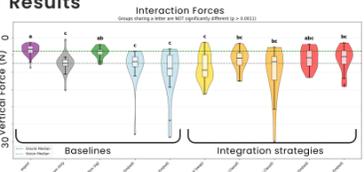
Architecture



Integration Strategies



Results



Policy Success Rates: No significant difference between all baselines and integration strategies.

Interaction Quality (Forces):

- Instrumented** policy can effectively mimic forces of **Expert demonstrations**.
- Vision-Only** acts **"blindly"**, resulting in high variance and excessive force.
- Frozen AST Embeddings** proves to be the **most promising approach**, successfully recovering the delicate interaction profile of the **Expert demonstrations** and **Instrumented** policy.

Future work: Investigating if these interaction benefits hold true across different button mechanisms and tactile switches.

Samuele Dell'Oca



Kranjska Gora, Slovenia | 12th February 2026



SUPSI

Sustainable
Production
Systems
Lab

When Robots Understand Humans

*HarmoniCo: Intention-aware adaptive
collaborative system*

Samuele Dell'Oca



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Lab

Context

Dynamic and unstructured
manufacturing environments involving
both operators and cobots





Cobots are mostly used in automation setups because of their **limited intelligence** and **lack of context awareness**

Cobots **can't adapt their behavior** to avoid conflicts and enhance collaboration with humans

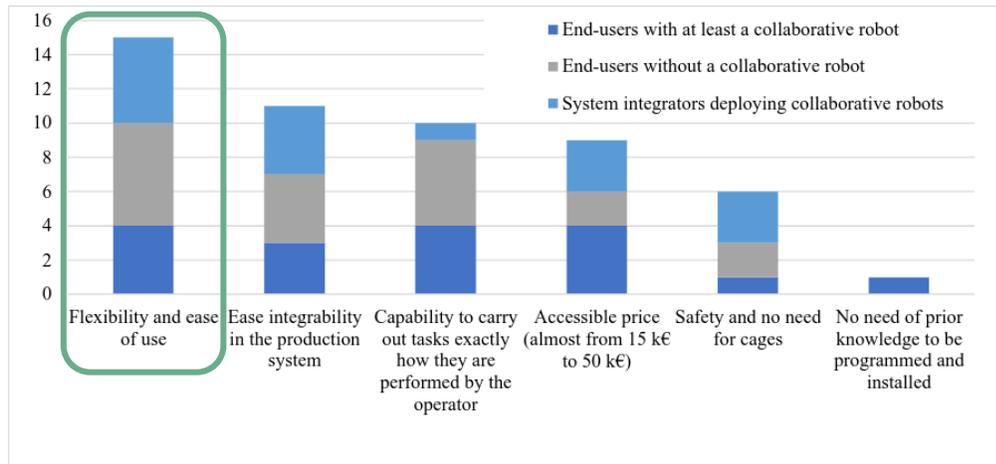




SoA: Human Robot Collaboration

Cobots are designed to **complement** human abilities

End-user still asking for more cobots **flexibility** and **intelligence** [1]



Need to interpret human intentions to adjust cobot actions





To teach cobots how to **infer** humans' intention

To **adapt** cobots behavior and **complement** humans' actions

*Human intention is defined as a **finite** set of **short-term actions***





SoA: Intention Prediction Models

Machine Learning approaches:

DL models [2], LSTM networks [3],
Multimodal ML [4], Self-supervised ML [5]

Probabilistic approaches:

PSM [6], MDP [7], GMM [8]

Current models are predominantly task-specific and target a single use case





Development of a **task-agnostic** and **adaptable** Intention Prediction Model:

- Needs specific **configuration**, **task discretization**, **data collection** and dedicated **training** for each scenario
- Relies on a **common structure** representing the configuration of the system and can be **easily adapted** to fit different scenarios

	Parameter	Description	Example
Context-related	$Conf(t)$	It represents the scenario configuration (i.e., its elements status)	[1,0,1,1,0]
Dynamic human-related	P_{eyes}	Position of the center between the eyes [x, y]	[317,127]
	P_{nose}	Position of the nose tip [x, y]	[315,138]
	P_{right}	Position of the right hand [x, y]	[378,243]
	P_{left}	Position of the left hand [x, y]	[484,138]
Human experience and preferences-related	D	Operator dominant hand (right=1, left=0)	1



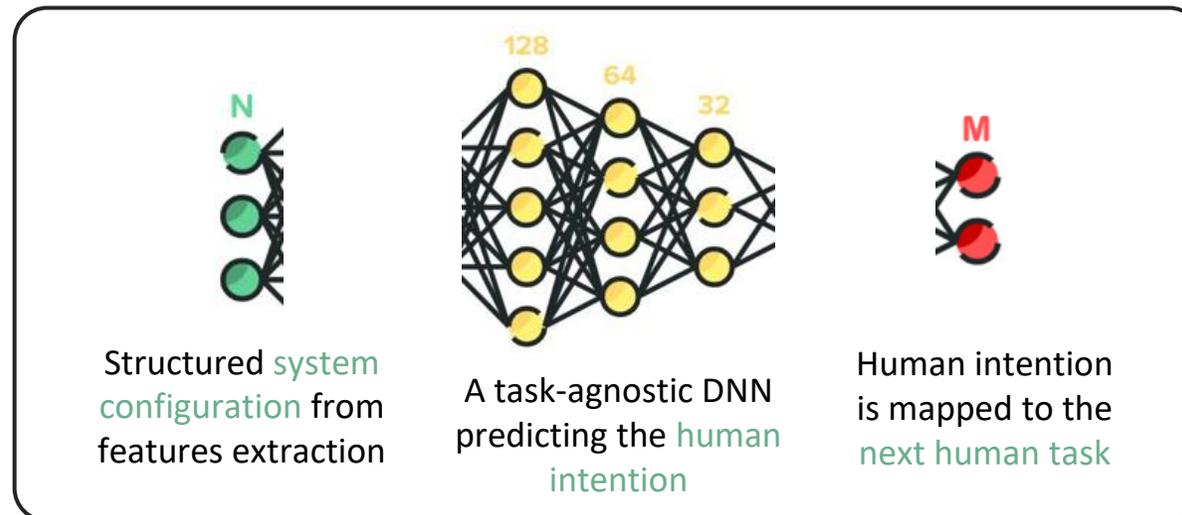
CASE 2025



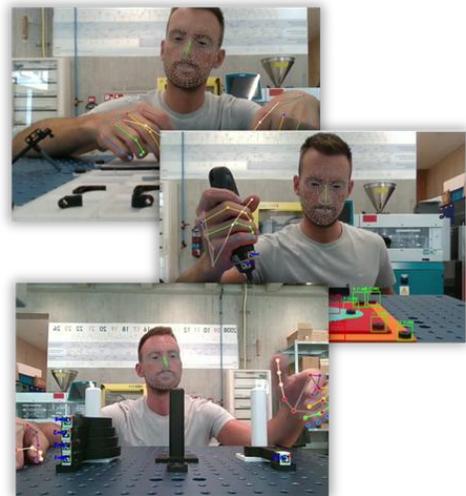
The Intention Prediction Model

Classification model which predicts among a discrete set of short-term tasks through a Feed-forward Neural Network (discrete tasks = classes)

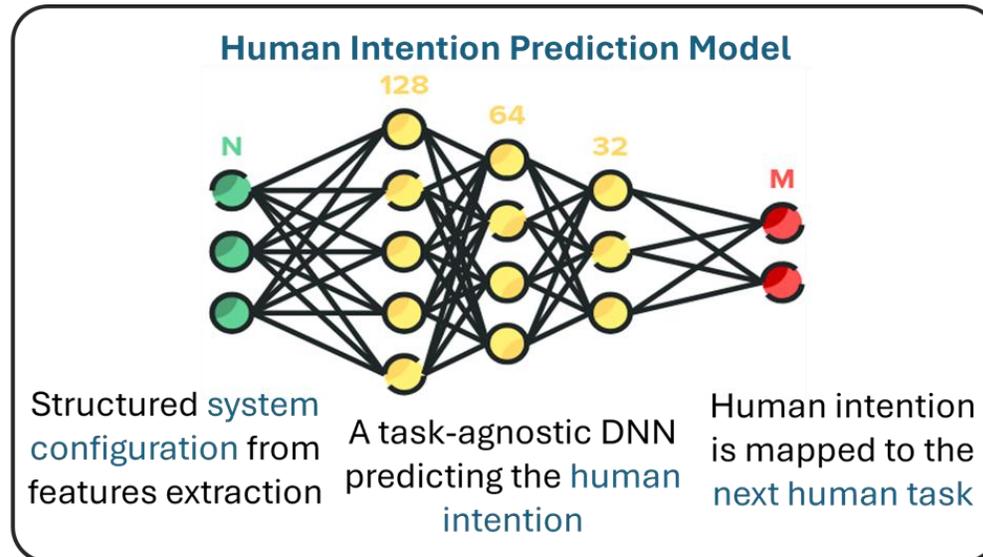
To support different scenarios, it is sufficient to adjust input and output size



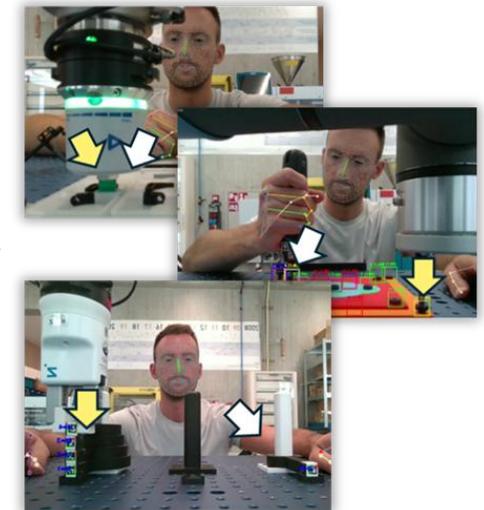
Workflow



Input: vision system recognizes objects and human features



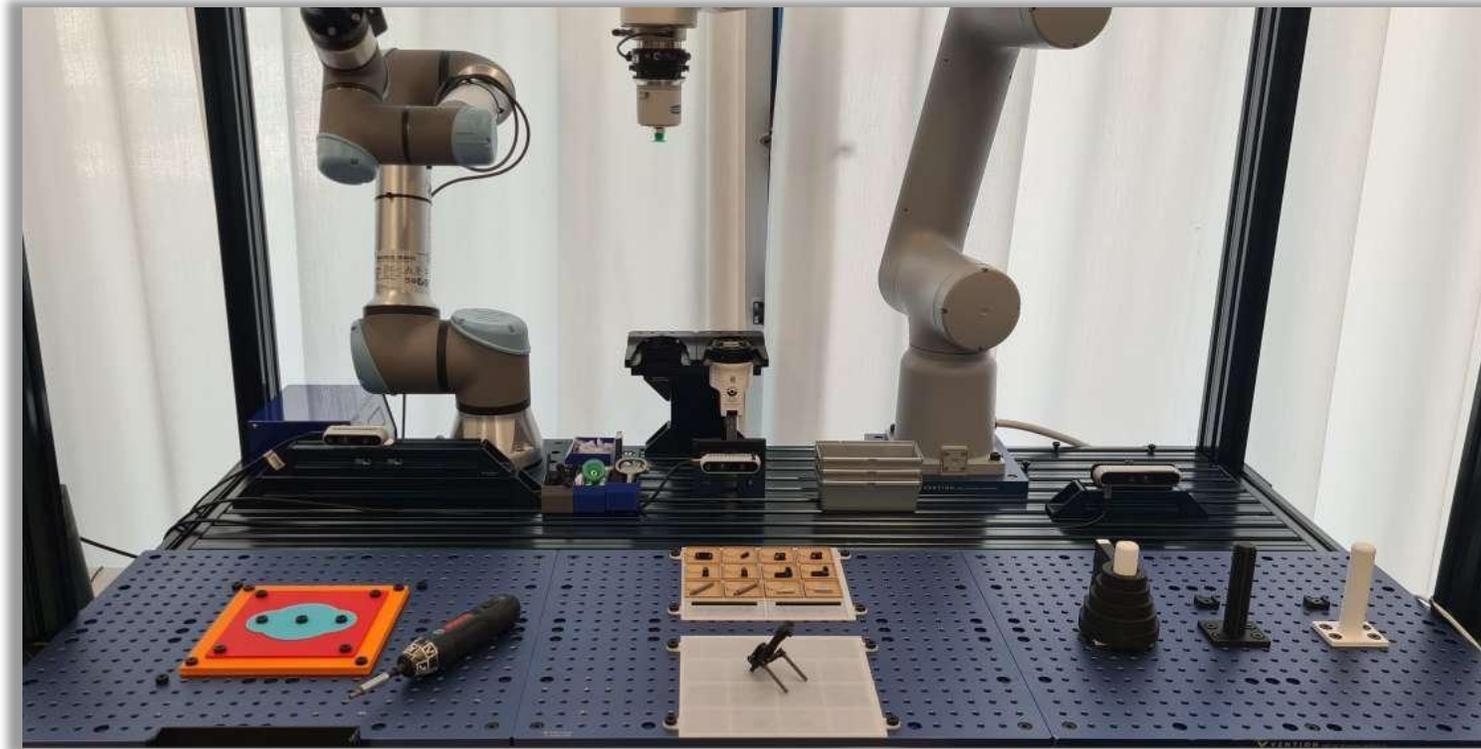
Predicted human task supports the smart robot **task assignment**



Output: human intention + robot task



Validation Scenarios



1

Piece
disassembly

2

LEGO®
assembly

3

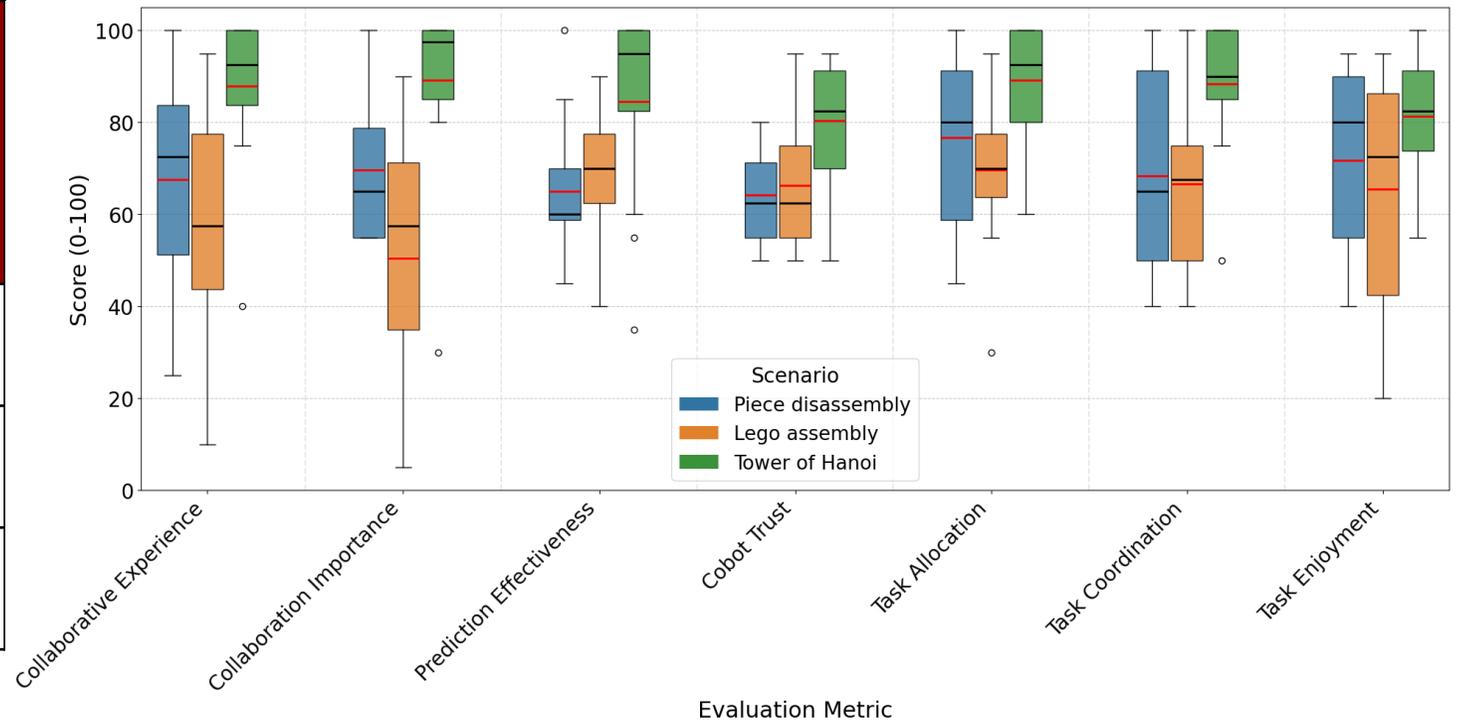
Tower of
Hanoi



Quantitative metrics

Scenario	Training accuracy (%)	Individual validation accuracy (%)	Collaborative validation accuracy (%)
Piece disassembly	98.2	83.1	49.0
LEGO® assembly	98.4	77.6	94.2
Tower of Hanoi	98.5	89.9	82.5

Qualitative metrics





Limitations

The IPM is not fully aware of the scenario state and has limited training data

Need for a finite task discretization and custom task assignment logic for each scenario

Lack of efficiency and smoothness in the automation part

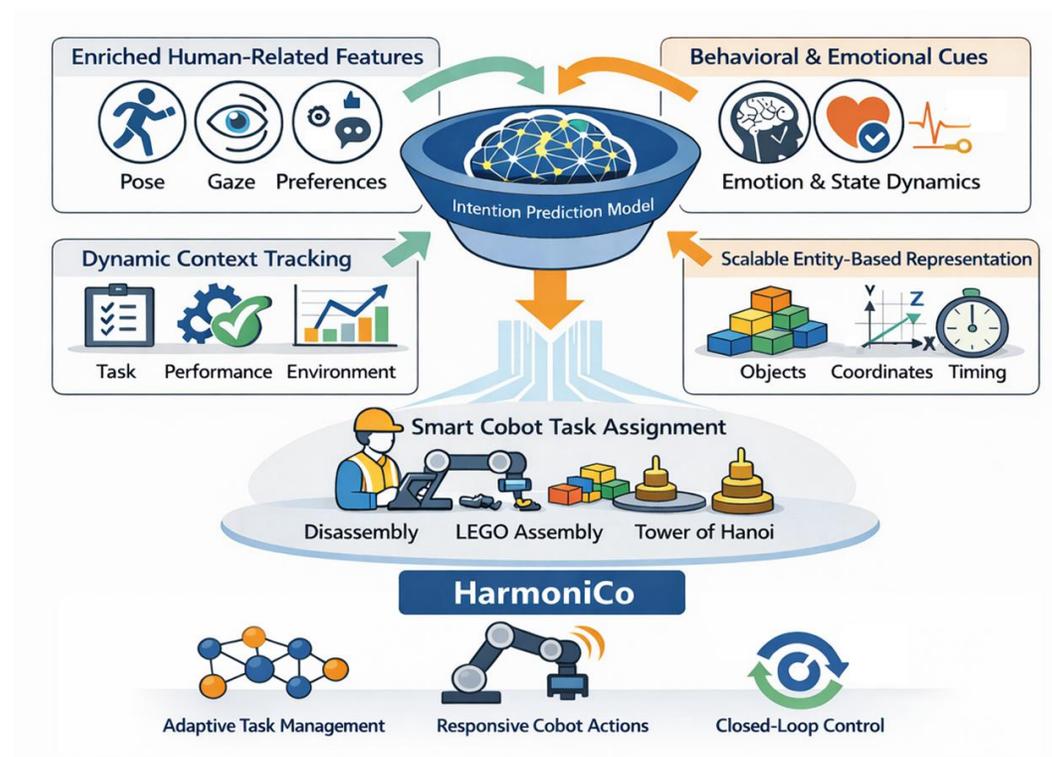
The cobot cannot reallocate its tasks in real-time



Support **dynamic task management**

Exploration of **new model features** →

Leverage a **single, more generic entity-based Intention Prediction Model**





Development of a more scalable and efficient task assignment logic, allowing for cobot task reallocation in real-time

Provision of system feedback and reasoning explainability

Development of more complex industrial scenarios





- [1] Montini, E., Daniele, F., Agbomemewa, L. et al. Collaborative Robotics: A Survey From Literature and Practitioners Perspectives. *J Intell Robot Syst* 110, 117 (2024)
- [2] J. Laplaza, F. Moreno, and A. Sanfeliu.: Enhancing robotic collaborative tasks through contextual human motion prediction and intention inference. *International Journal of Social Robotics* (2024)
- [3] Gao, X., Yan, L., Wang, G., Gerada, C.: Hybrid recurrent neural network architecture-based intention recognition for human–robot collaboration. *IEEE Transactions on Cybernetics* 53, 1578–1586 (2021)
- [4] Ni, S., Zhao, L., Li, A., Wu, D., Zhou, L.: Cross-view human intention recognition for human-robot collaboration. *IEEE Wireless Communications* 30, 189–195 (2023)
- [5] Abbate, G., Giusti, A., Schmuck, V., Celiktutan, O., Paolillo, A.: Self-supervised prediction of the intention to interact with a service robot. *Robotics and Autonomous Systems* 171, 104568 (2024)
- [6] Awais, M., Henrich, D.: Human-robot collaboration by intention recognition using probabilistic state machines. *19th International Workshop on Robotics in Alpe-Adria-Danube Region (RAAD 2010)* pp. 75–80 (2010)
- [7] McGhan, C.L., Nasir, A., Atkins, E.M.: Human intent prediction using Markov decision processes. *Journal of Aerospace Information Systems* 12(5), 393–397 (2015)
- [8] J. Lyu, P. Ruppel, N. Hendrich, S. Li, M. Görner, J. Zhang.: Efficient and collision-free human–robot collaboration based on intention and trajectory prediction. *IEEE Transactions on Cognitive and Developmental Systems* 15(4), 1853–1863 (2022)

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LinkedIn



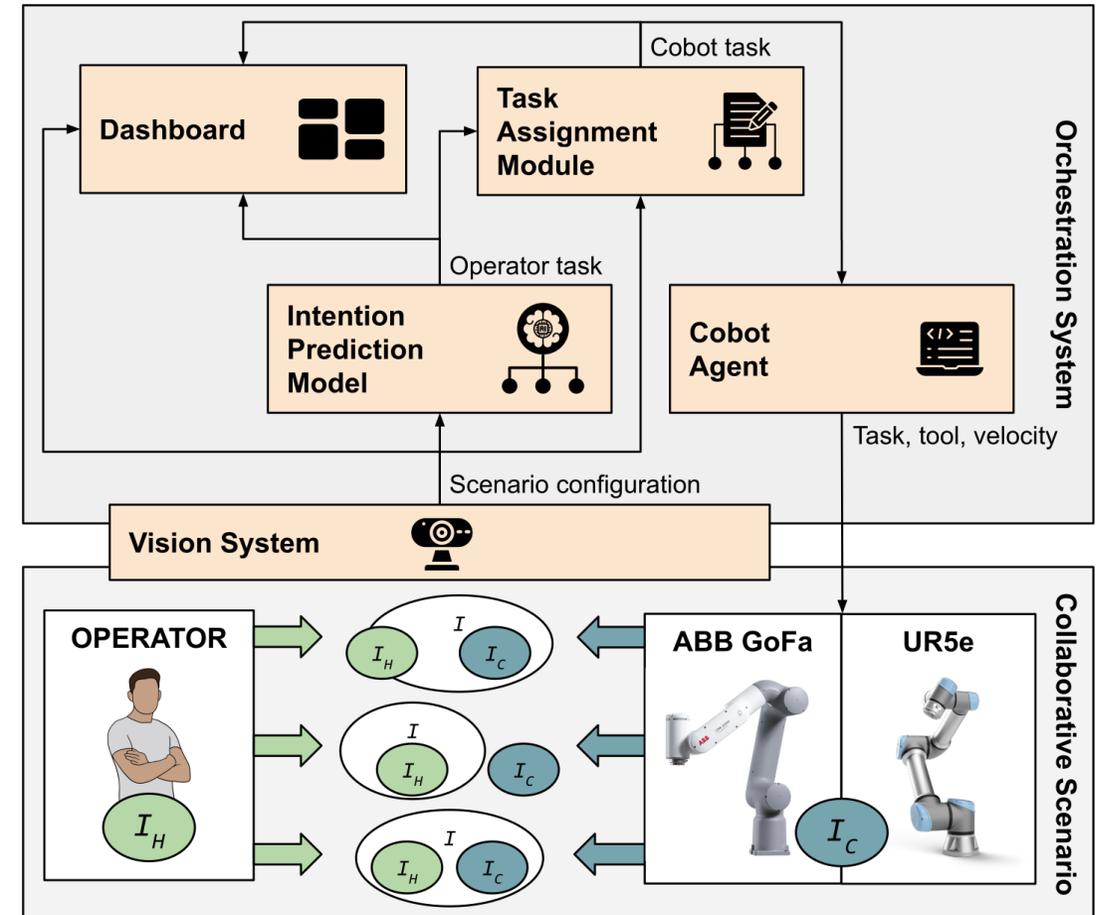
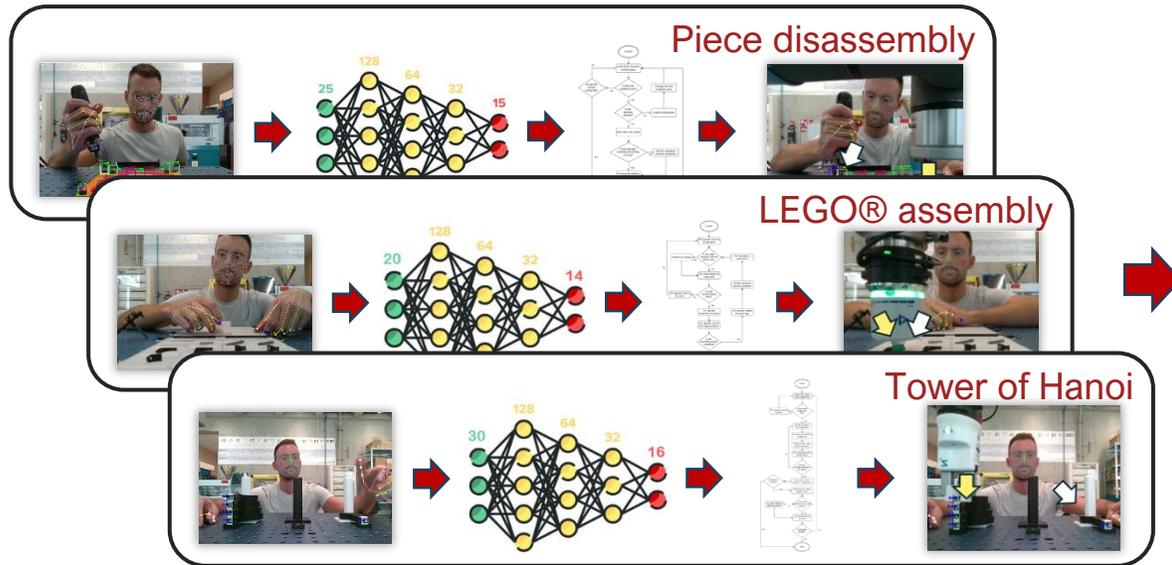
SPS Lab

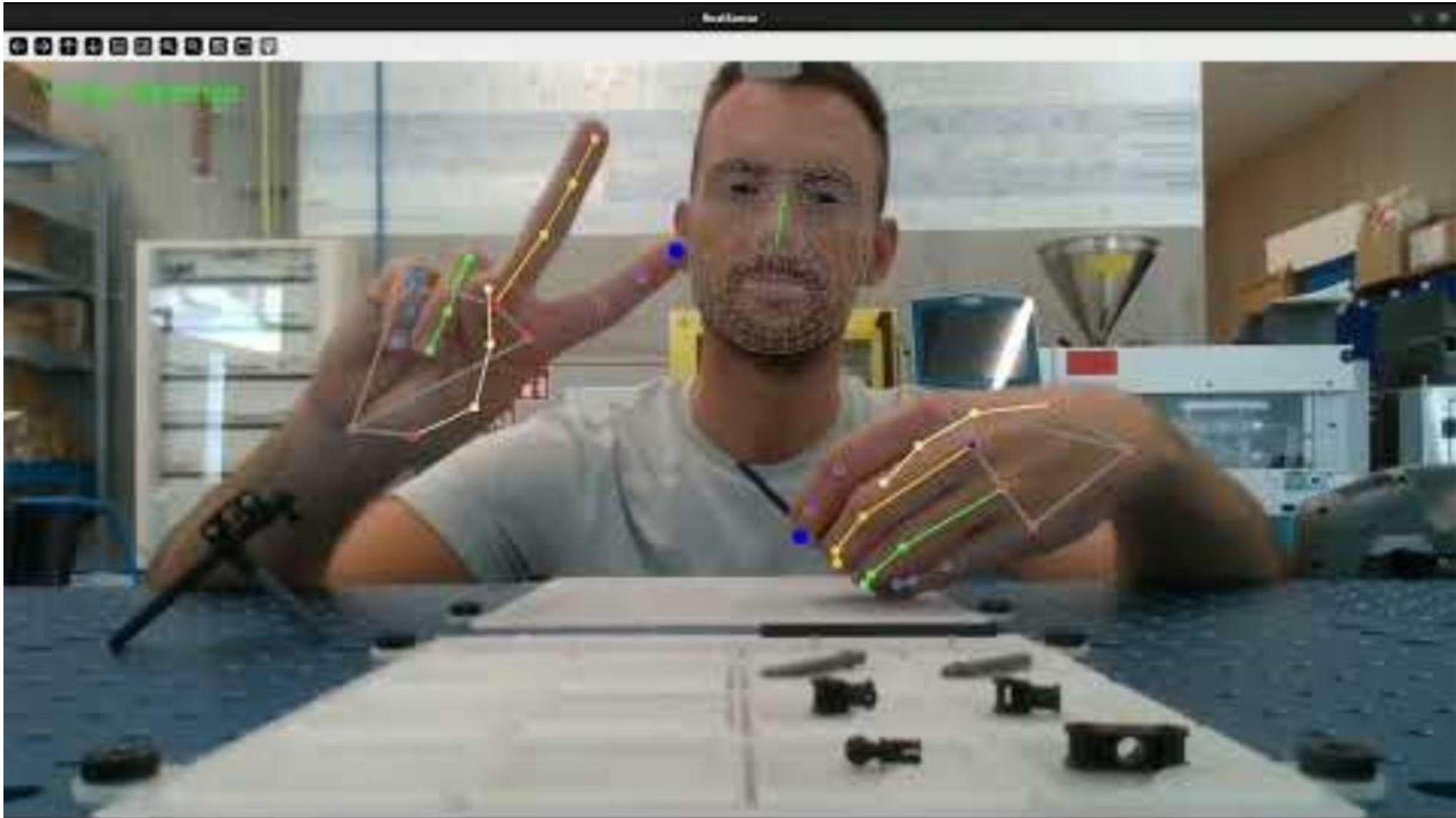


Collaborative Work Cell
(SUPSI Mini Factory)



System's architecture





Thomas Haspl

Sensitive Robot-based Gripping

*Handling of deformable and damageable
Objects through Pressure Sensor Arrays*

*ROMANDIC Winter School
Feb., 9th - Feb., 13th 2026*

 Thomas Haspl

 joanneum.at/robotics

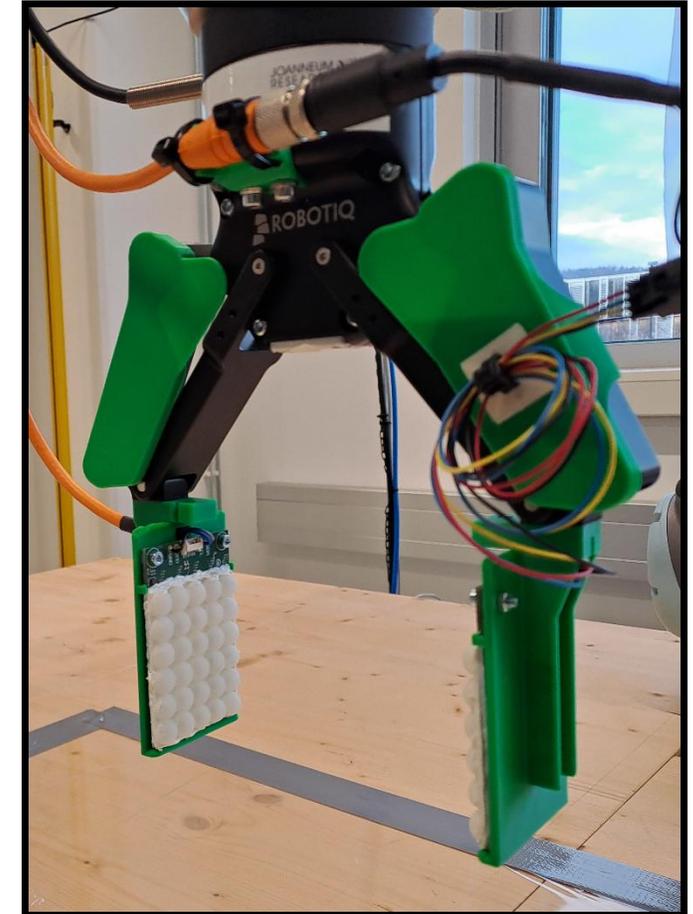
 thomas.haspl@joanneum.at

Technological Basis

Tactile Sensor Arrays

Based on barometric Pressure Cells

Arrays of 5x3 or 6x5 Sensor Cells

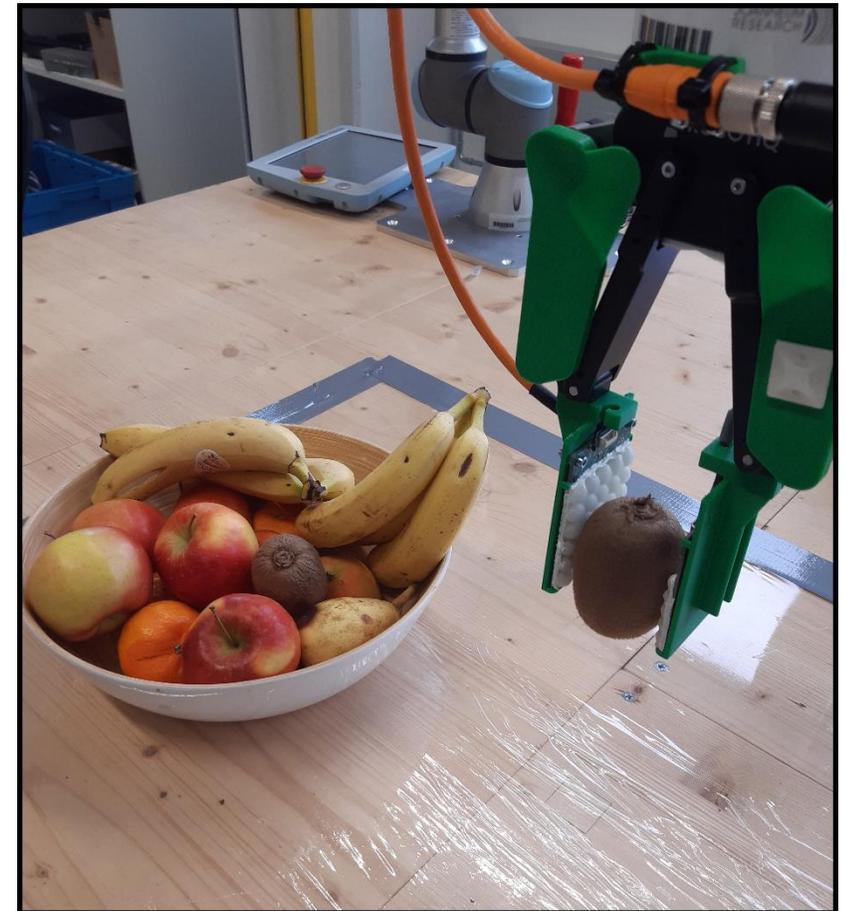


Application to robotic Systems

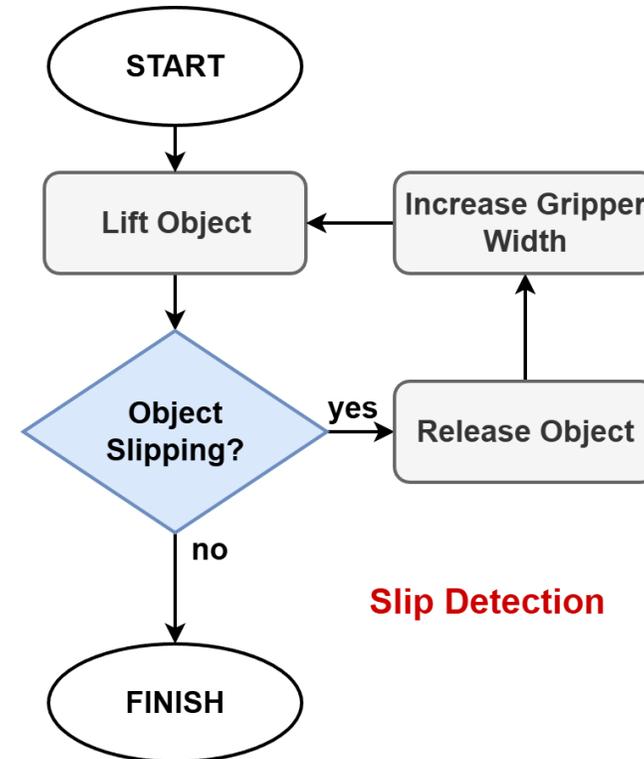
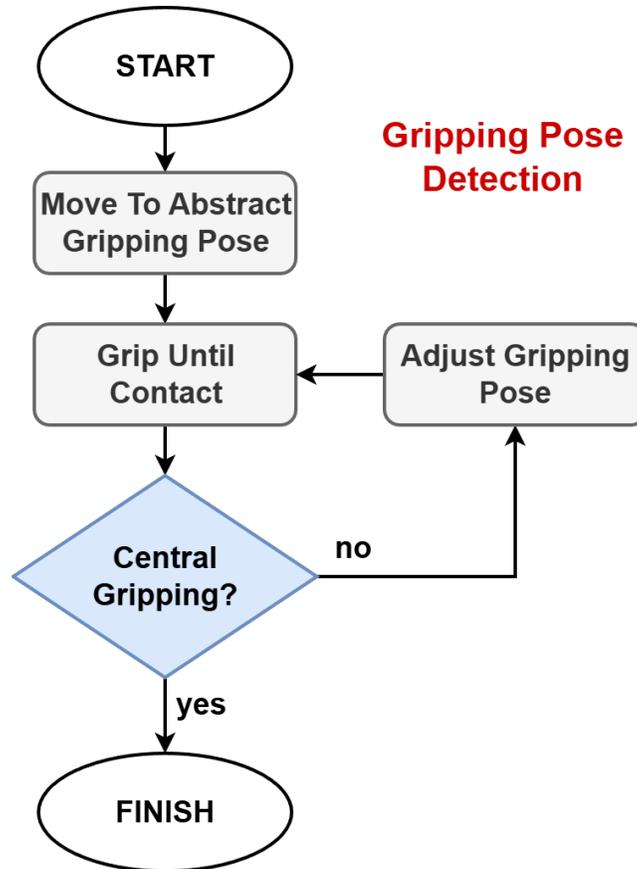
Integration into 2-Finger-Gripper

Implementation of overall Control System

Definition and Implementation of Applications



Application to robotic Systems





JOANNEUM RESEARCH

Forschungsgesellschaft mbH

ROBOTICS

Institut for Robotik und Flexible Production

Lakeside

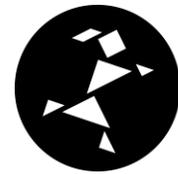
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Project ROMANDIC Grant agreement ID: 101159522



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Karlsruher Institut für Technologie

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