ROS End-Effector

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@ ROS-Industrial Conference 2019

ROS End-Effector

- **Main goal** of the project:

> Provide the **industrial** and **research communities** with a **ROS-based software component** with **standardized** interfaces capable of **controlling a wide range of robotic end-effector**s in an **agnostic** fashion

https://github.com/ADVRHumanoids/ROSEndEffector

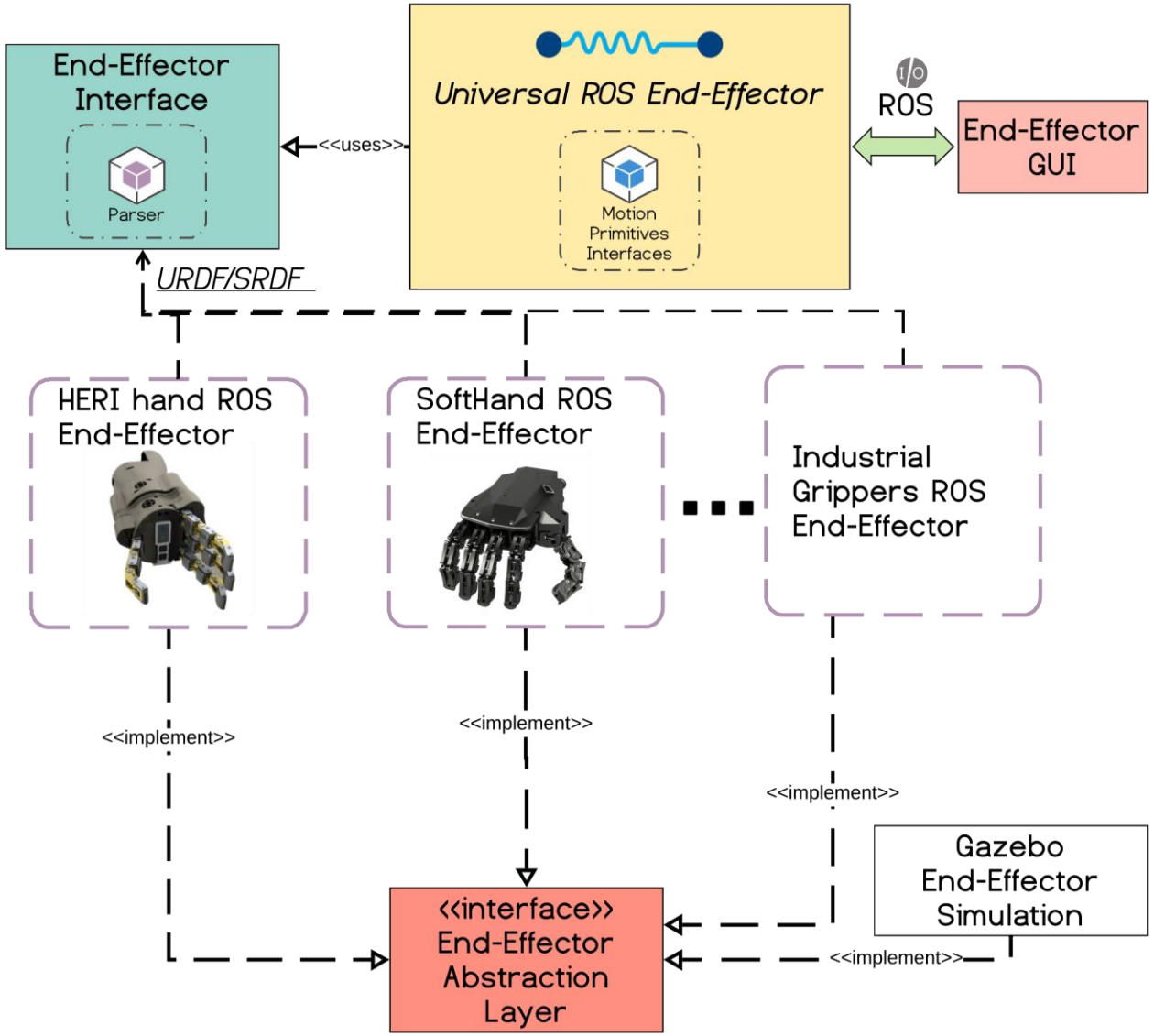
ROS End-Effector: Motivations (1/2)

- In the last few year, **many robotics end-effectors have been developed** to provide manipulation capabilities to industrial robotics systems.
- **Their integration relies on customized software modules** and **interfaces** that is **specific** for each end-effector:
  - it requires the development of new software modules and interfaces that is **time consuming** and certainly **not efficient.**
- **Avoid customized and complex software wrappers,** difficult to test and maintain

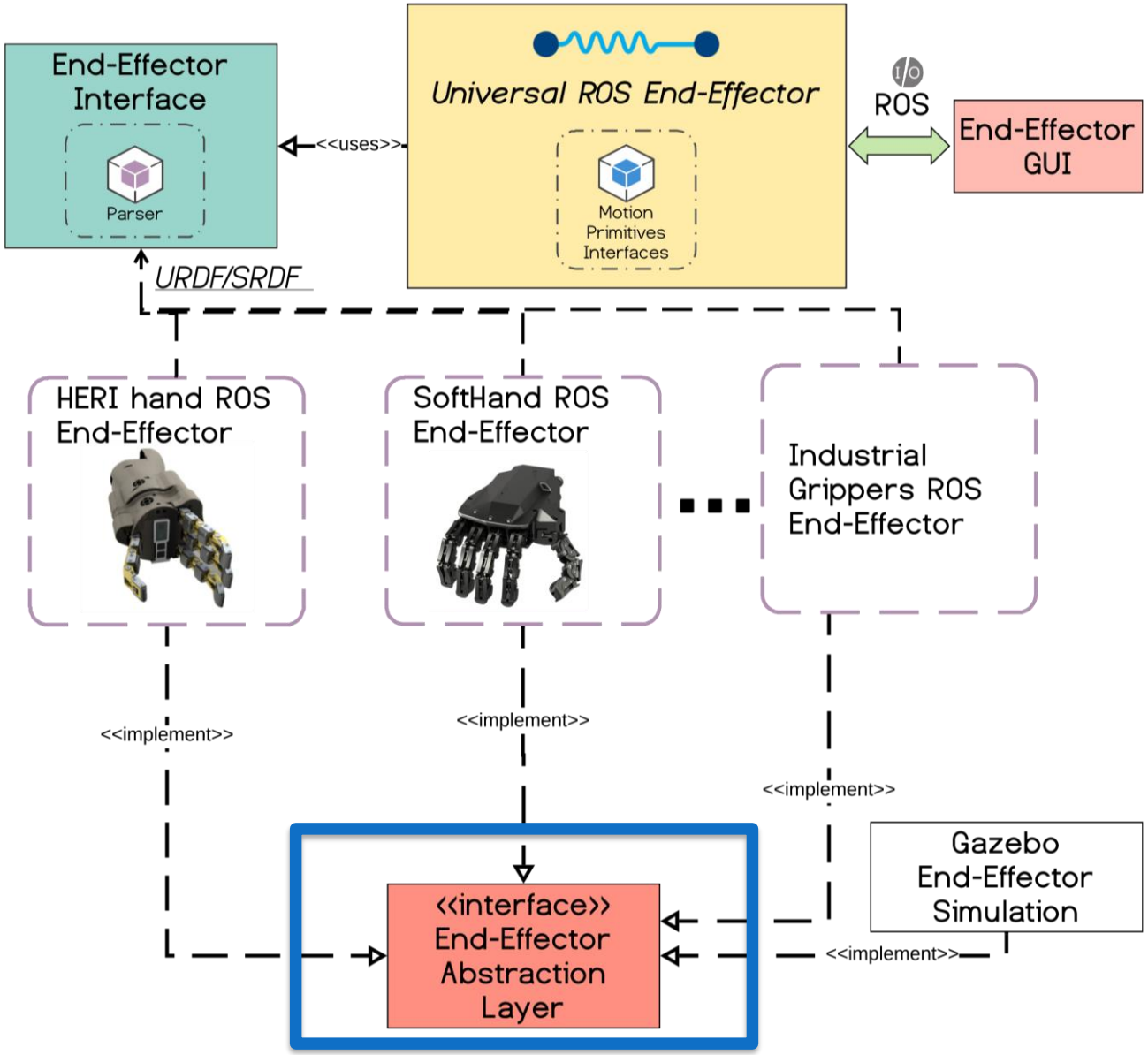
ROS End-Effector: Motivations (2/2)

- Most of the **existing industrial grippers are capable of employing only a single grasping pattern**:
  - **more advanced interfaces** to utilize the full functionality of these robotic hands **are required**
- In fact, the **recent development of CoBots** has created the necessity in the industry of improving and extending the capabilities of robot end-effectors in terms of not only grasping and manipulation but also of what concerns end-effector sensing and human machine interfaces:
  - This improves the interaction and collaboration between the robot and the human worker.

ROS End-Effector: Overview

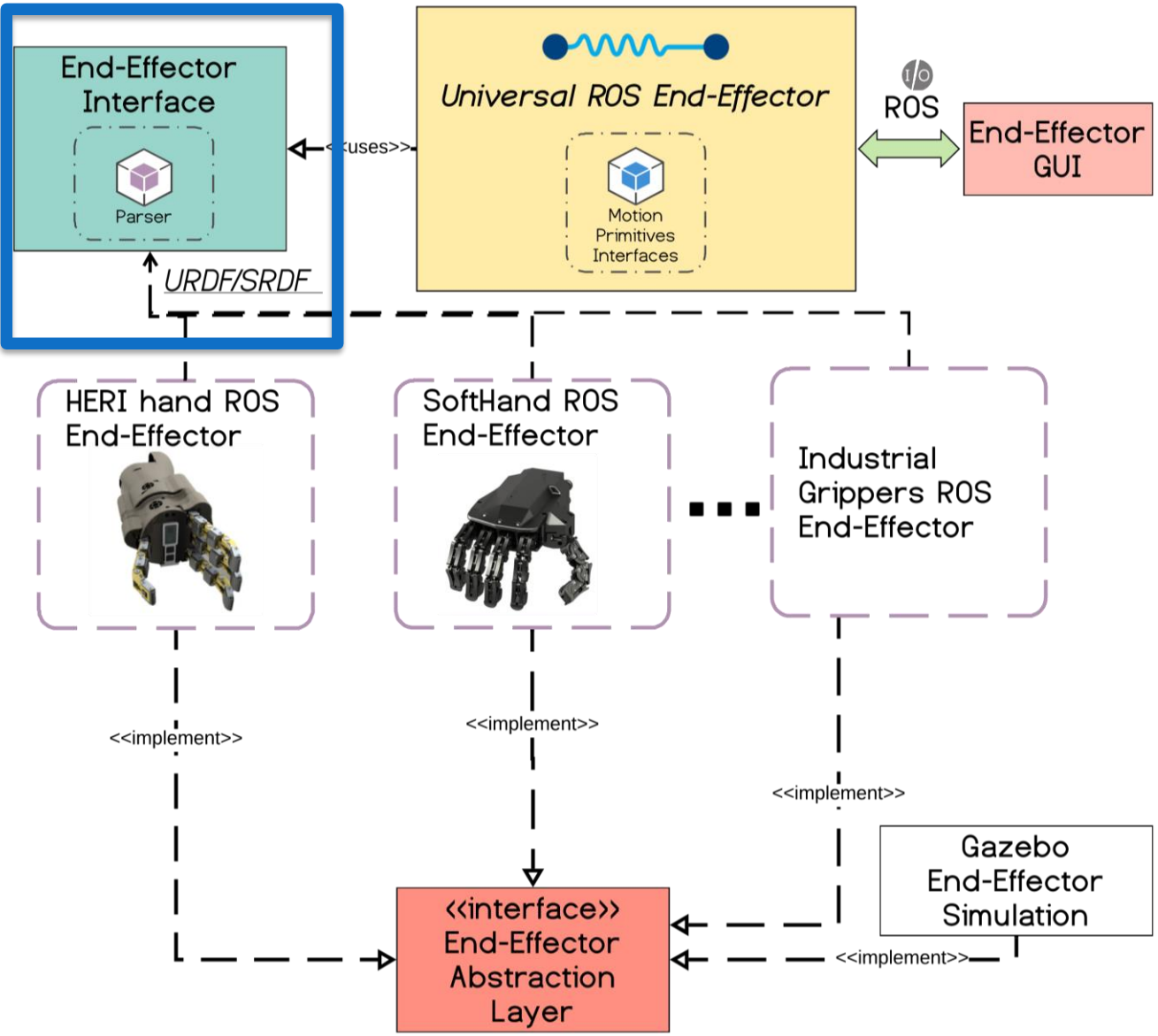


End-Effector Abstraction Layer



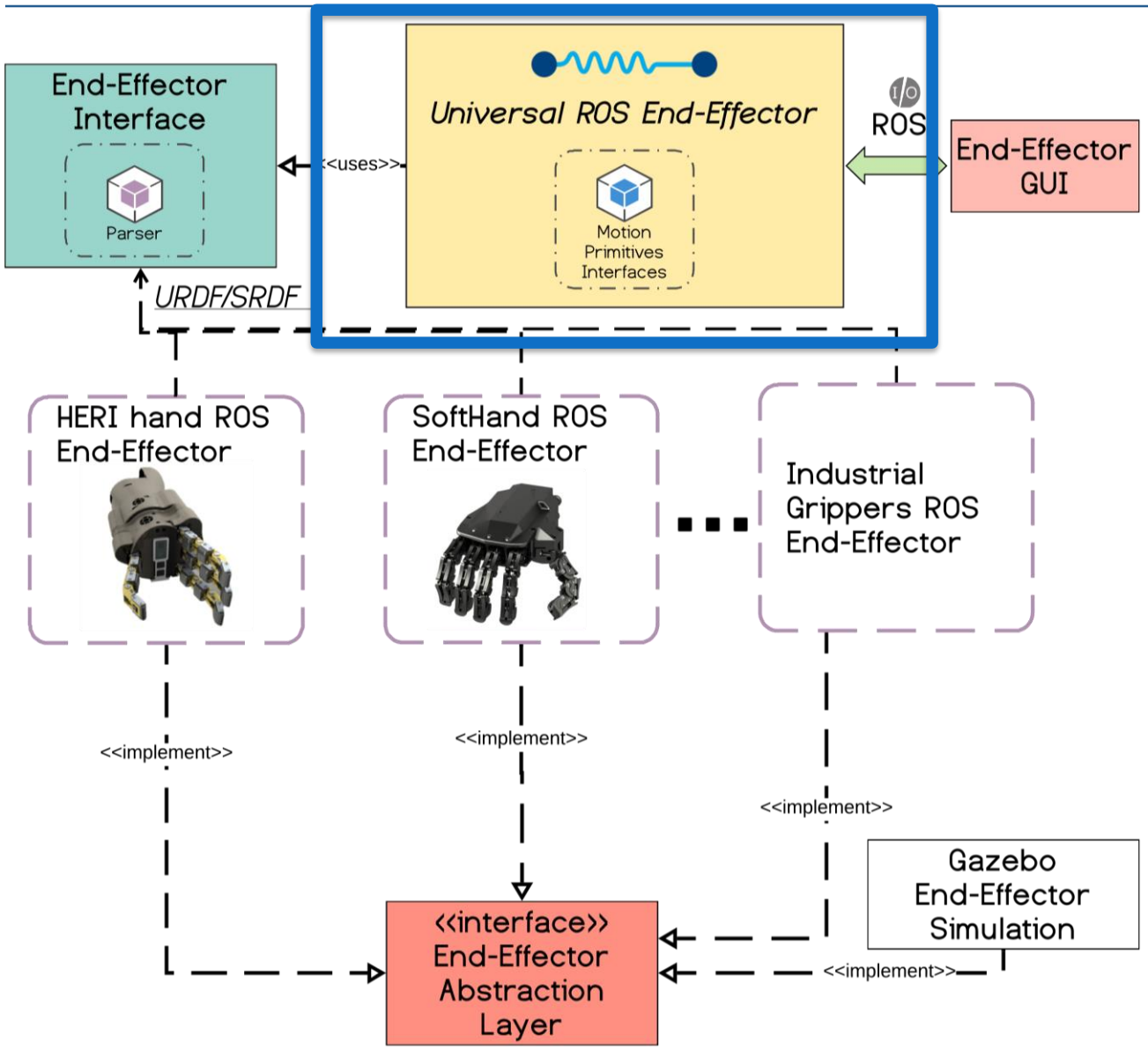
- A robotic end-effector can be considered as a **complex distributed system composed by a set of hardware devices communicating** through a **fieldbus**
- Provide a **software layer on top of the hardware/simulation** capable to **abstract** the details of the specific end-effector/simulation environment in use
  - Expose a set of interfaces with two pure virtual methods:
    - **sense()**
    - **move()**

End-Effector Interface



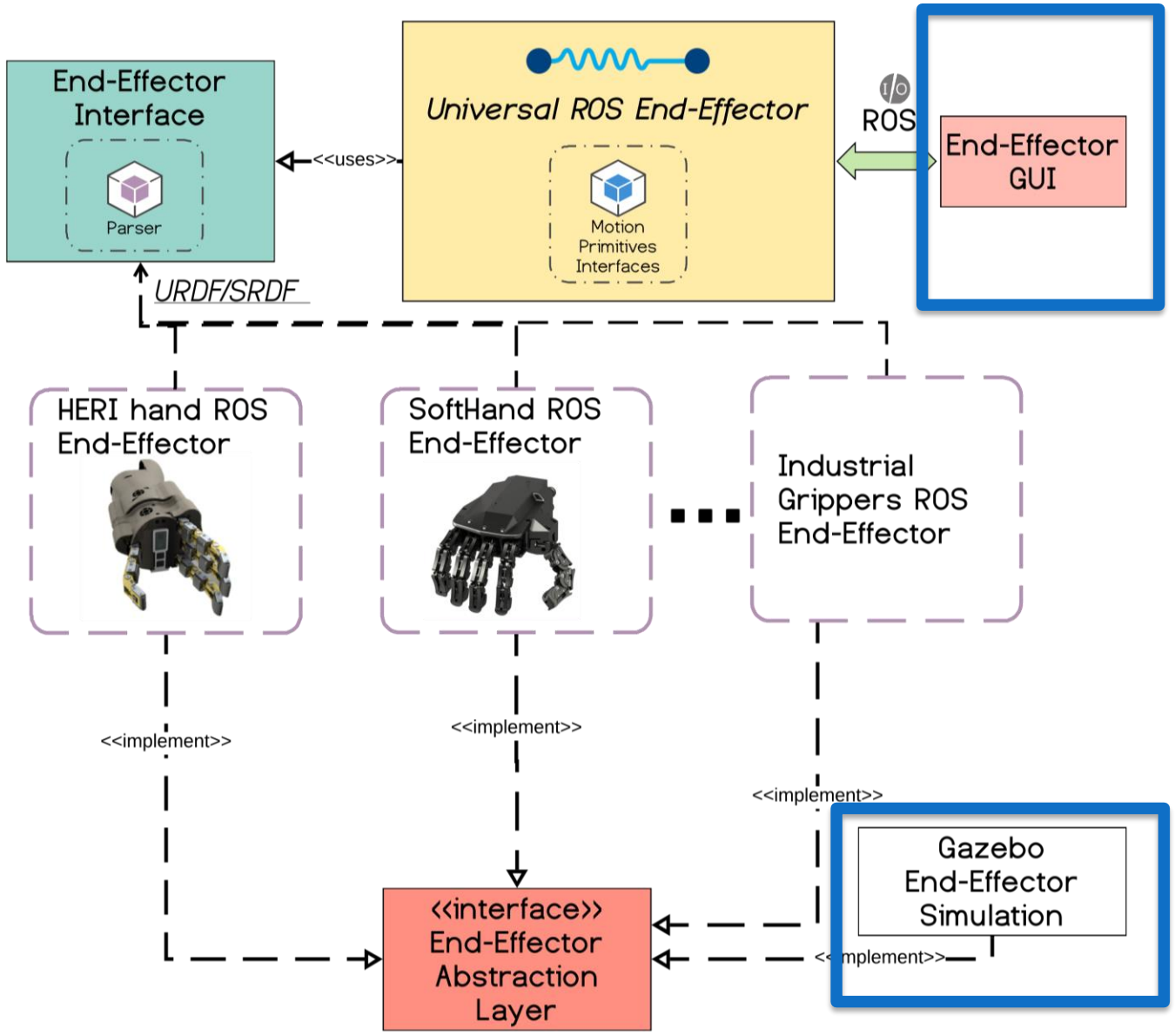
- Take as an **input the URDF and SRDF of the end-effector** in use
- Build up a **dynamic End-Effector API** based on:
  - the **fingers** (i.e. kinematic chains),
  - the **actuated joints inside each finger** chain.
- Provide a **standardized set of interfaces** which accommodates a range of robotic end-effectors with different hardware capabilities

Universal ROS End-Effector



- **ROS node** which uses the End-Effector Interface and the End-Effector Abstraction Layer implementation to **control a generic robotic End-Effector**
- It provides a set of r**eady to use grasping primitives** based on the the End-Effector in use

GUI and Simulation: on-going work



ROS End-Effector

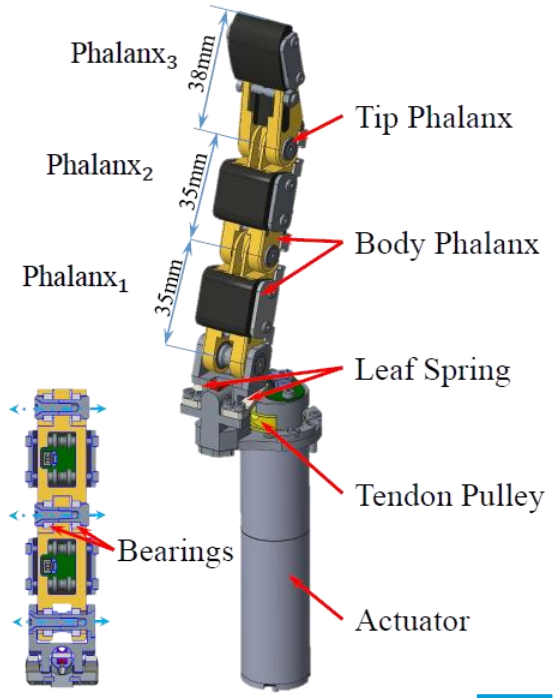
- **Impact** of the project:

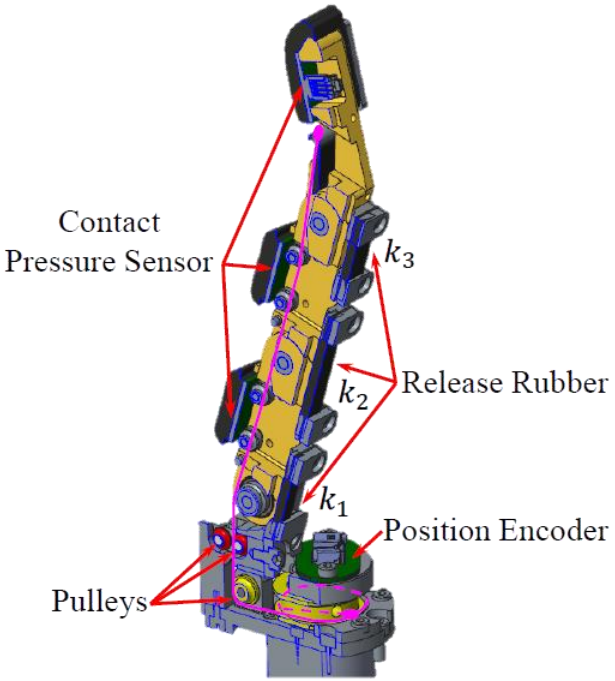
The developed ROS Package is expected to impact the **utilization of the new robotic end-effectors** by **facilitating their integration**, **use** and **validation** in the **industrial environments,** effectively contributing to **making the transition period from prototypes to exploitable end-effector devices shorter**

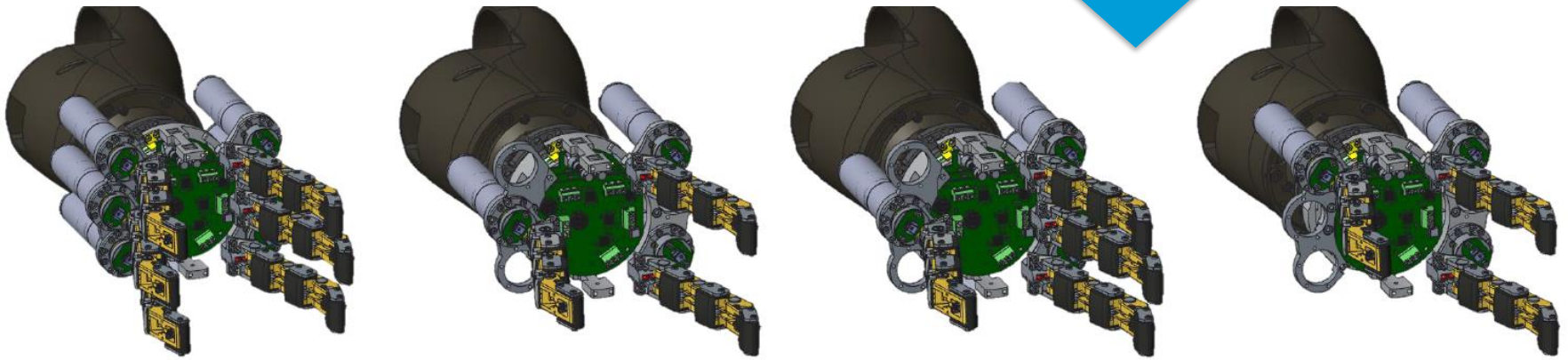
HERI: A Modular and versatile end-effector

Design principles

- Under-actuated modular finger
- Compliant structure and transmission
- Phalanx contact pressure sensing
- Simple Tendon Arrangement

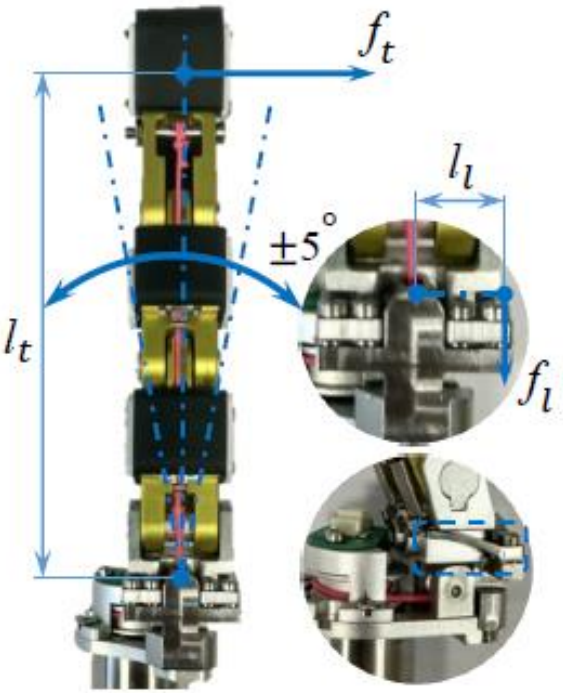


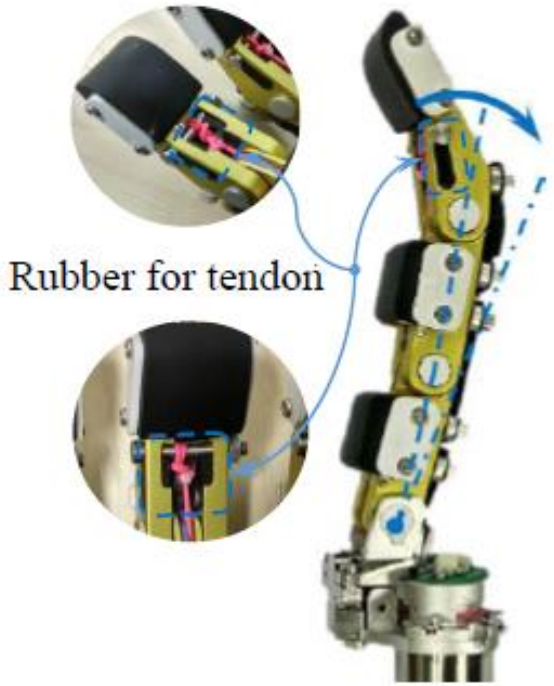




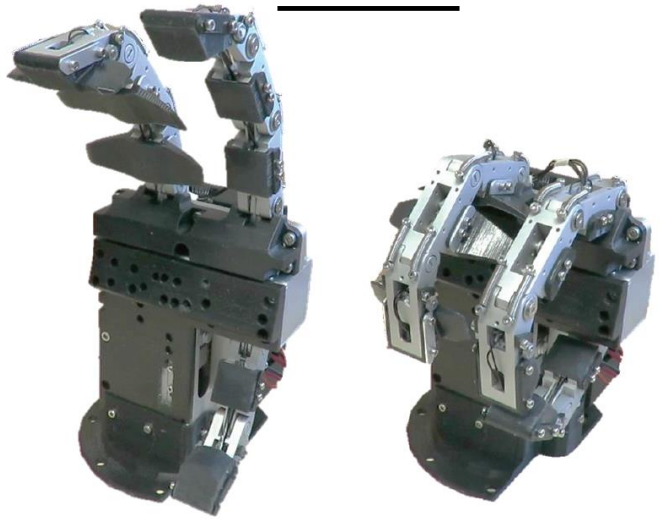
HERI: A Modular and versatile end-effector

Prototypes



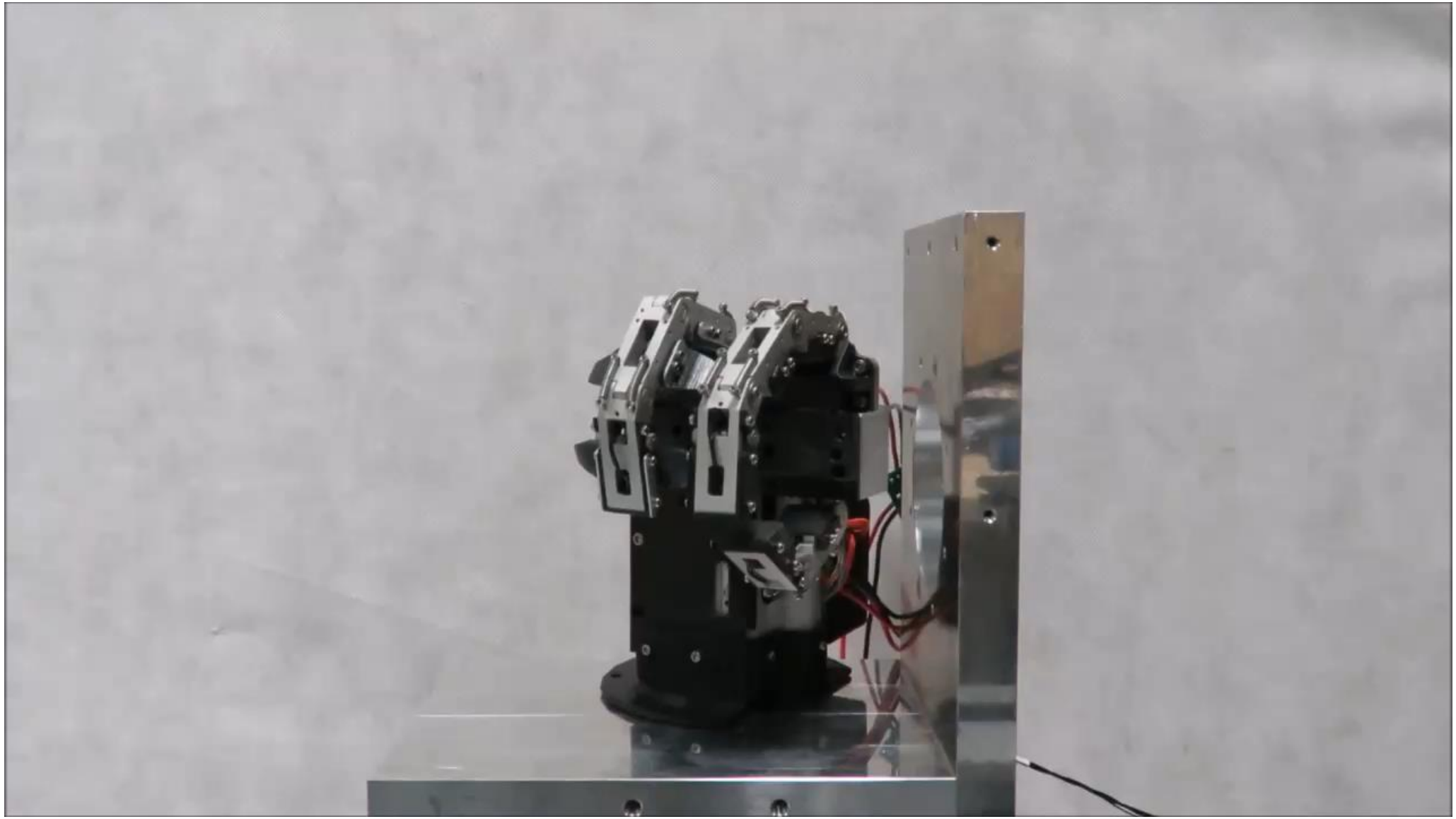


HERI I



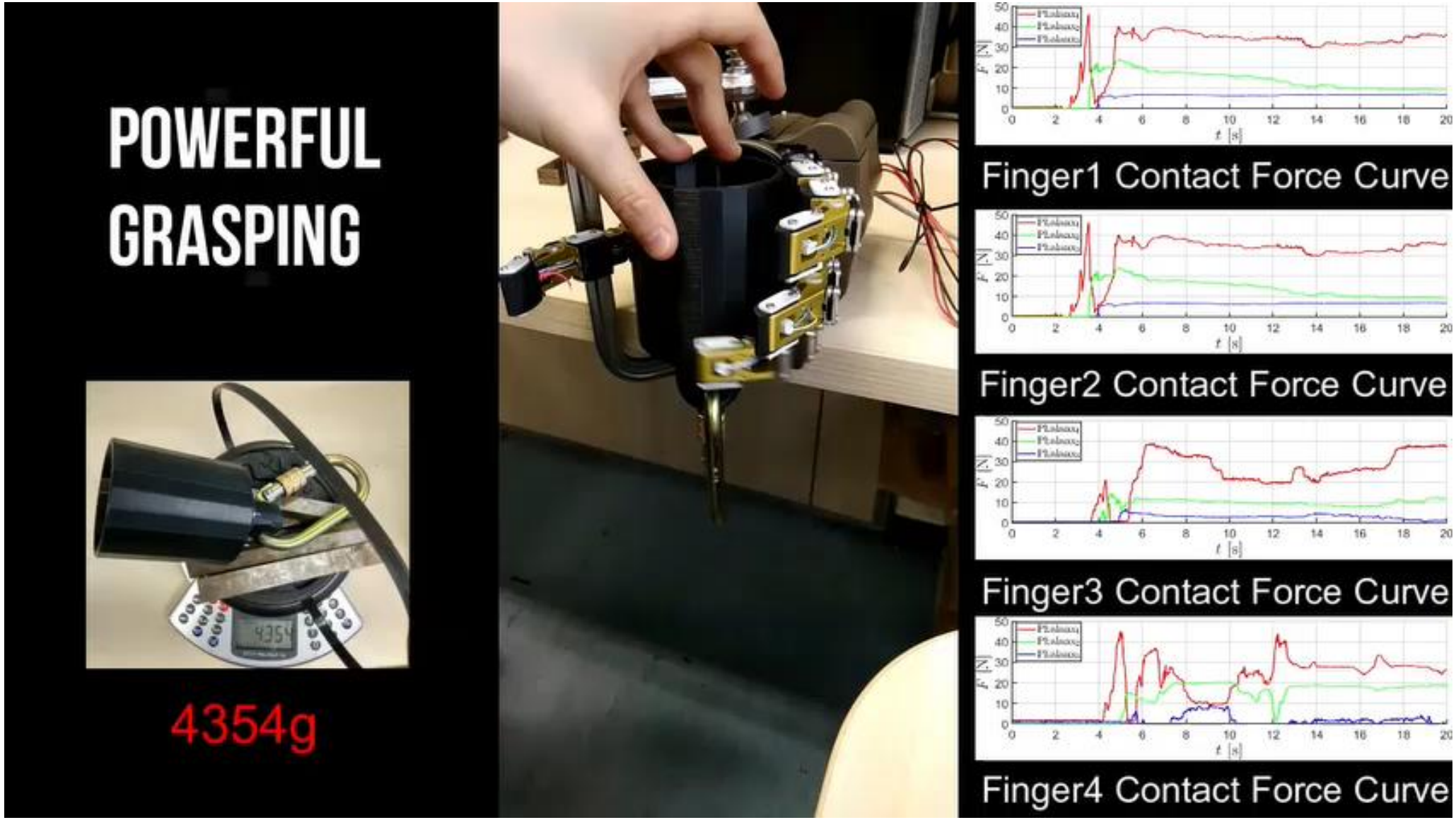
HERI II

HERI I Prototype



HERI II Prototype

Primitive grasping and manipulation capabilities



HERI II Prototype

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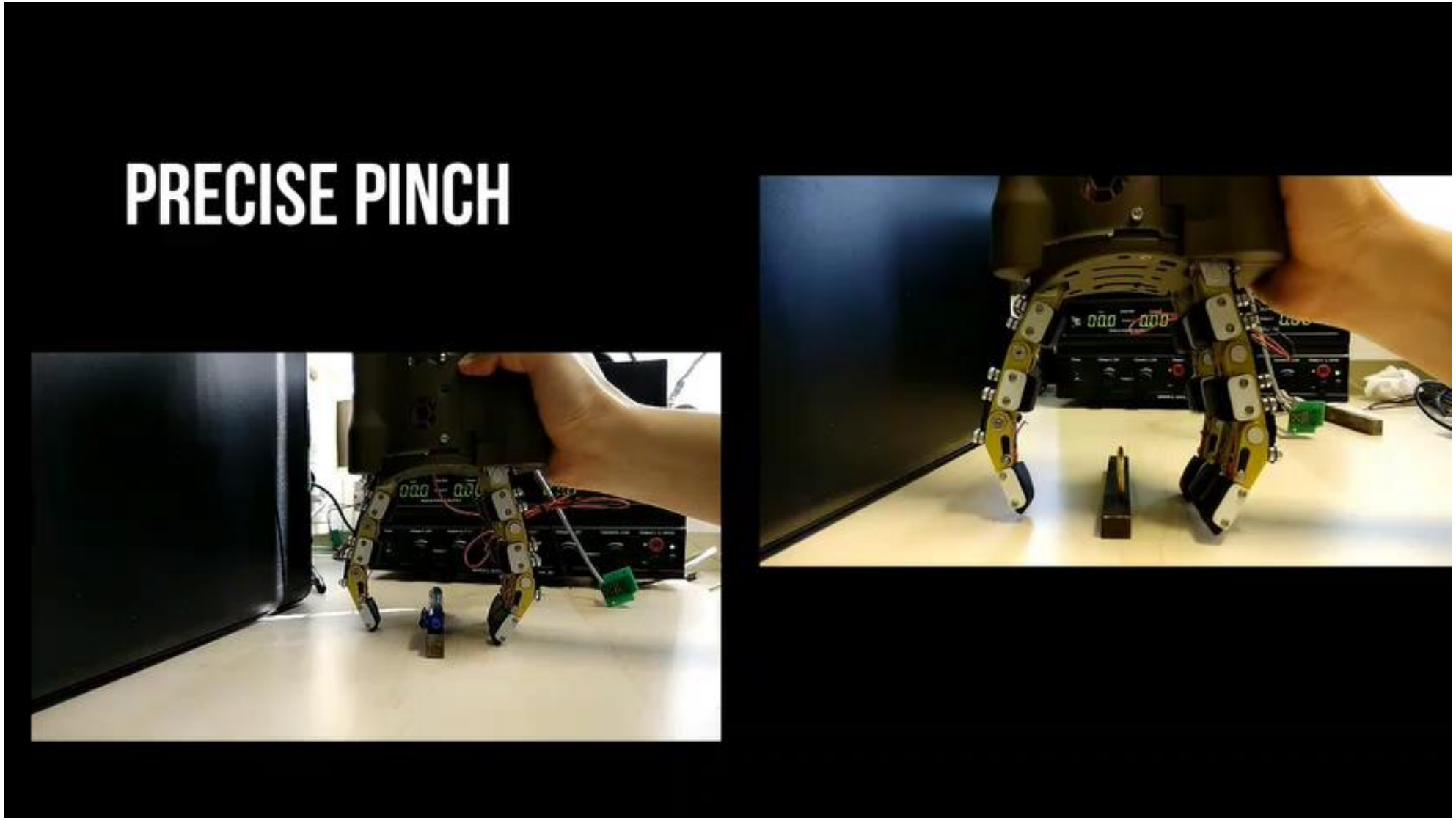
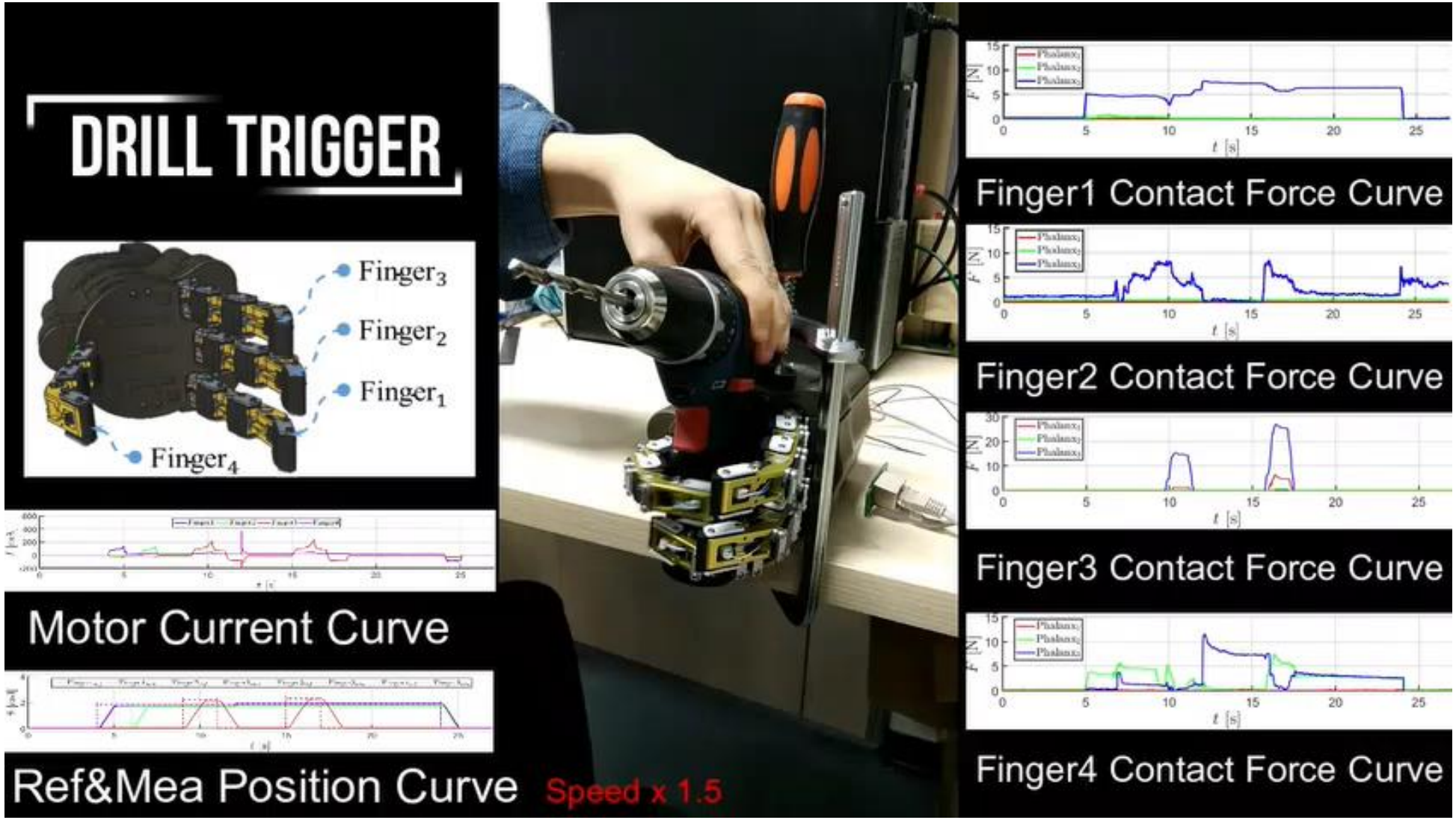


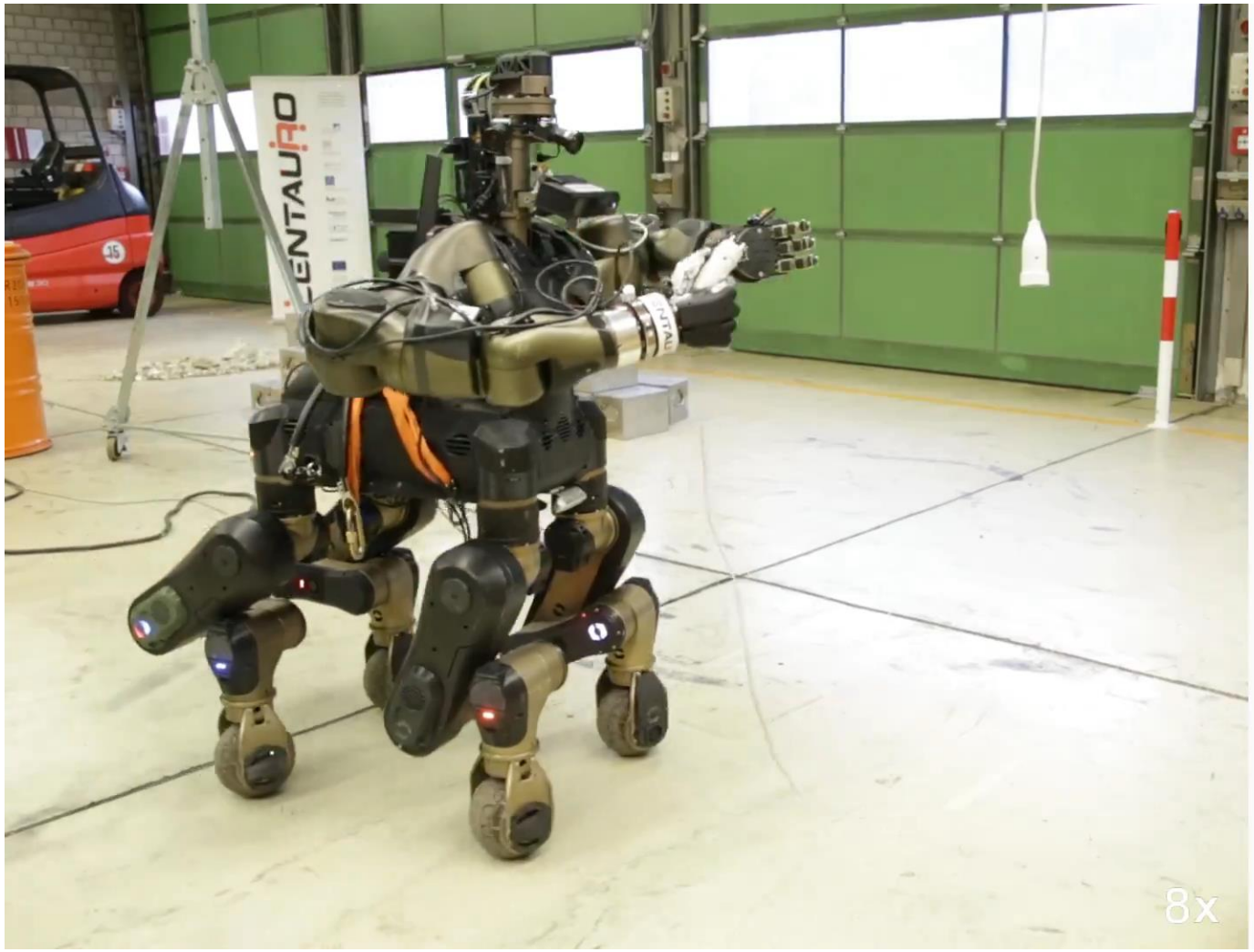
HERI II Prototype

Modular and versatile robotic hand



HERI II Prototype

Mounted on Centauro robot



Locomotion Tasks

Manipulation Tasks

- Fire Hose
- 230V Connector (Standard)
- 230V Connector (CEE)
- Shackle
- Electrical Screw Driver
- Power Drill

Combined Tasks

Autonomous Tasks

Tele-presence Suit

HERI II Prototype

Mounted on INAIL Collaborative Arm

New HERI III : On going work within ROSIN End-effector

Main upgrades

- Three fingers hand
- Improved overall form factor
  - Optimized finger phalanx length
  - Reduced palm length and diameter
- Integrated HMI
- Integrated hand state display
- Variable contact sensitivity
- Fast mounting/removal interface

Questions?

- Thanks for the attention!

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