



FACULTY **institute**
OF MECHANICAL **of automation**
ENGINEERING **and computer science**

Programming for robots and manipulators

Lecture 3

1. Introduction
2. Different types of end-effectors
3. Special/Futuristic End-effector
4. How to choose the right End-effector?
5. End-effectors – LAB i4C

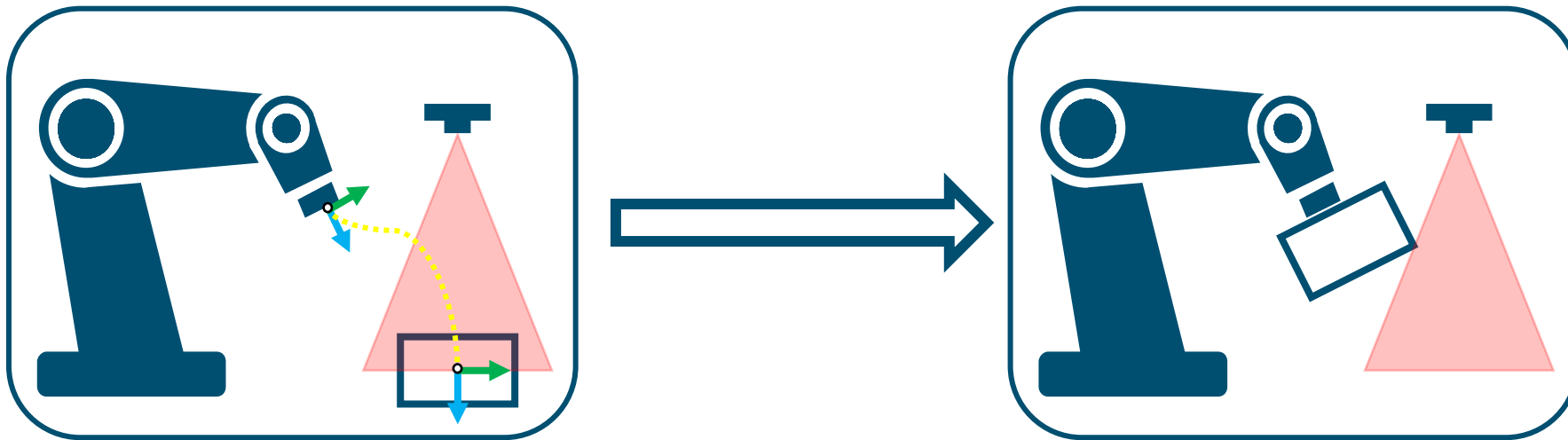


Introduction

Introduction

In robotics, an end-effector is the device at the end of a robotic arm, designed to interact with the environment. The exact nature of this device depends on the application of the robot.

End-effector is actually a subsystem of handling mechanism which provides a temporary contact with the object to be grasped. The Gripper ensures that the position and the orientation of the object that is grasped are constrained enough so that the process of carrying, joining etc is done efficiently.



Note: Choosing the right end-effector is essential for a reliable and productive robotic task!

Different types of end-effectors

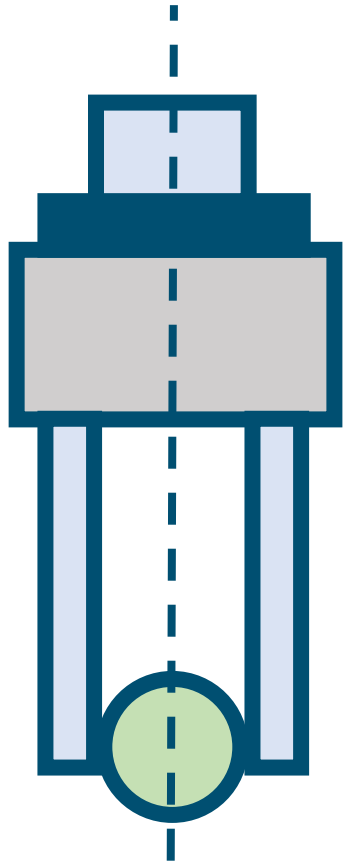
As the number of robot applications have expanded, so too have the different types of gripper which have been developed to suit the ever-growing range of tasks.

There are four main types of robotic end-effectors:

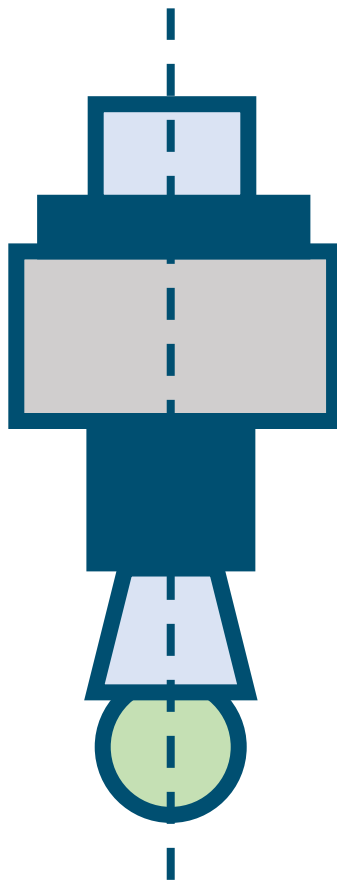
- Electric
- Pneumatic
- Vacuum
- Magnetic

Another area of robotic end-effectors is a special type (e.g., grippers inspired by nature), which is focused on gripping objects of various shapes.

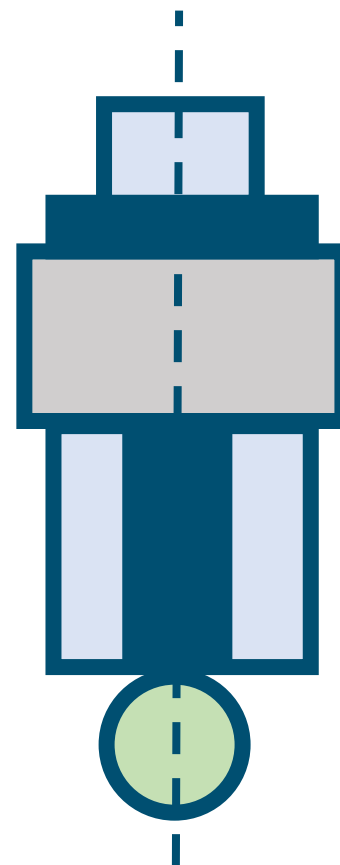
Different types of end-effectors



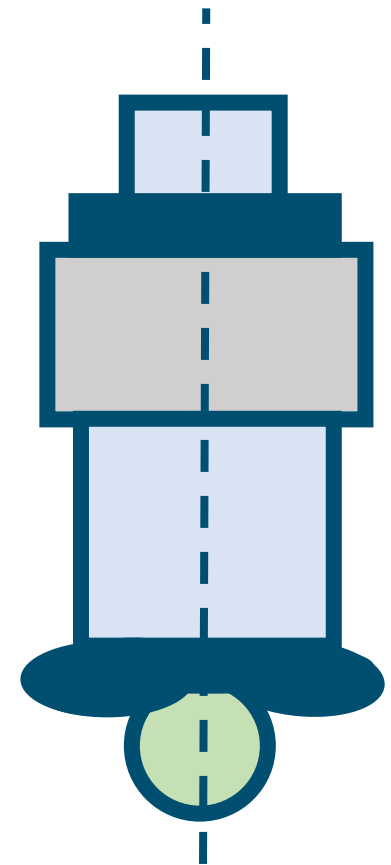
Electric/Pneumatic



Vacuum



Magnetic



Special

Electric End-effector

The servo-electric gripper appears increasingly in industrial settings, due to the fact that it is easy to control. Electric motors control the movement of the fingers using electrical input from the robot controller. These grippers are highly flexible and allow for different material tolerances when handling parts.

Some facts about the use of electric grippers:

- Control the position of the gripper.
- Detect grip.
- Control the grip force and speed.
- No air lines: save on power and maintenance.
- Cleaner grippers.

Applications: Bin-picking , Handling , Pick & Place, Machine tending, and more.

Pneumatic End-effector

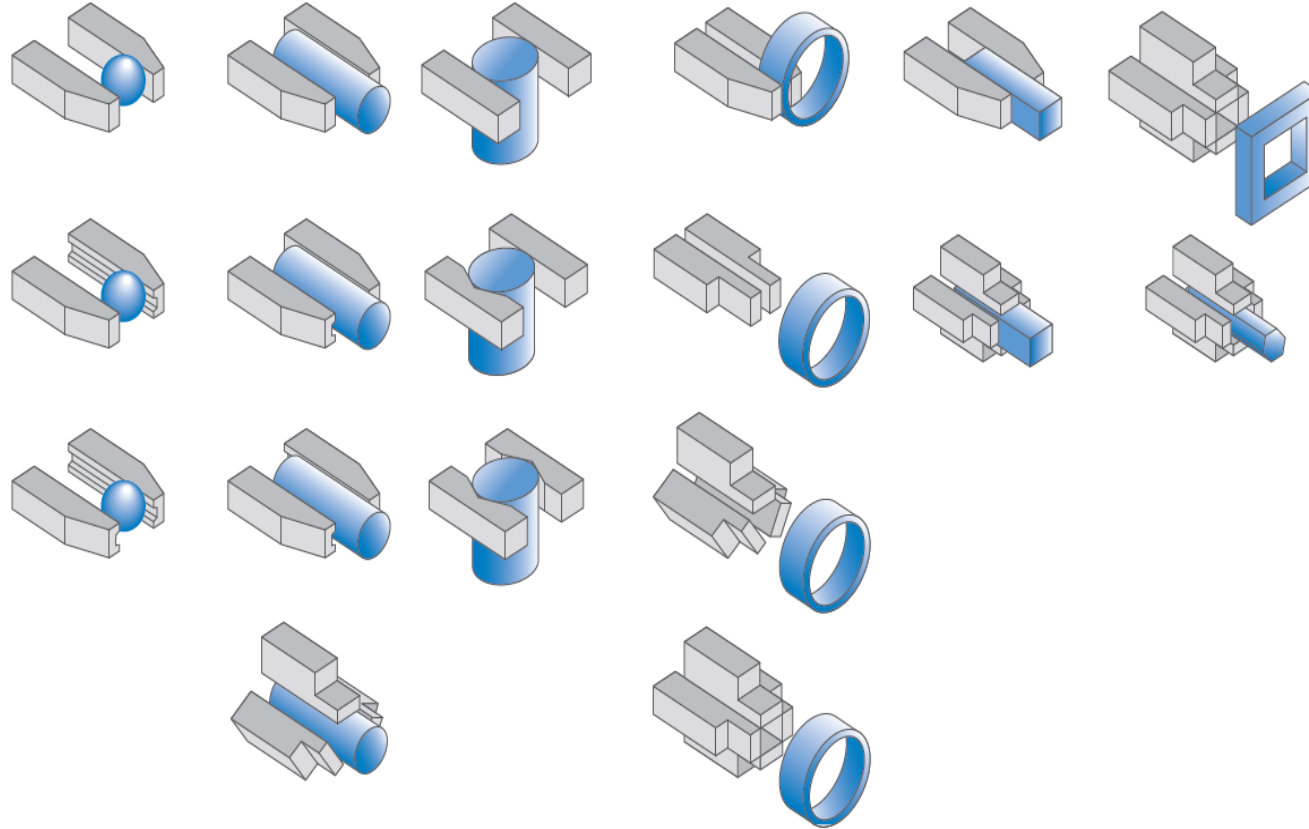
Pneumatic grippers use air to make them work. Usually, compressed air is forced through a piston to make it move. This movement can be parallel or angular. These grippers are popular due to its compact size and light weight. It can easily be incorporated into tight spaces, which can be helpful in the manufacturing industry. Pneumatic robot grippers can either be opened or closed.

Some facts about the use of pneumatic grippers:

- Gripper always at full stroke.
- Limited gripper force control.
- Limited gripper speed control.
- The usual problems with compressed air.
- No built in grip detection.

Applications: Bin-picking , Handling , Pick & Place, Machine tending, and more.

Electric/Pneumatic End-effector



Adaptability and interaction with the workpiece

Vacuum End-effector

Vacuum end-effectors or suction cups are simple devices that use vacuum parts to grip. They are cheap and provide good flexibility in material handling. They can be used with many types of materials, but cannot have perforated parts. Vacuum grippers are a very widely used type of robotic gripper.

Problems with different surfaces:

- Curved and sharply curved surfaces may not have sufficient contact of the flat surface with the gripper.
- Porous or wavy surfaces can prevent proper and repeatable suction.
- Dirty surfaces can clog air ducts.

Some facts about the use of vacuum grippers:

- It may leave marks on some surface.
- Need custom end of arm tooling to support them.
- The usual problems with compressed air.

Magnetic End-effector

Magnetic end-effectors are similar to suction cups, but can only be used with ferrous material. In addition, they do not have associated air costs and no material falls during air loss or power outages. These grippers are also simple and require low maintenance.

There are two types of magnetic end-effectors:

- Electromagnets
- Permanent Magnets

Some facts about the use of magnetic grippers:

- It only needs one surface to grab an object.
- Gripping speed is fast and flexible. Minimal maintenance.
- It can grip parts with holes which is not possible with vacuum grippers.
- Just a little oil on the surface can reduce the strength of the end-effector.
- Machining chips can stay on the gripper when unloading the piece.

Special/Futuristic End-effector

Special/Futuristic End-effector

Every year, several new unusual end-effectors appear in the robotic field. Control and construction of these end effectors can be difficult, but it is very flexible for robotic applications.



Righthand Robotics



Festo Grippers: Inspired by nature



Shadow Robot

Special/Futuristic End-effector



[Righthand Robotics](#)

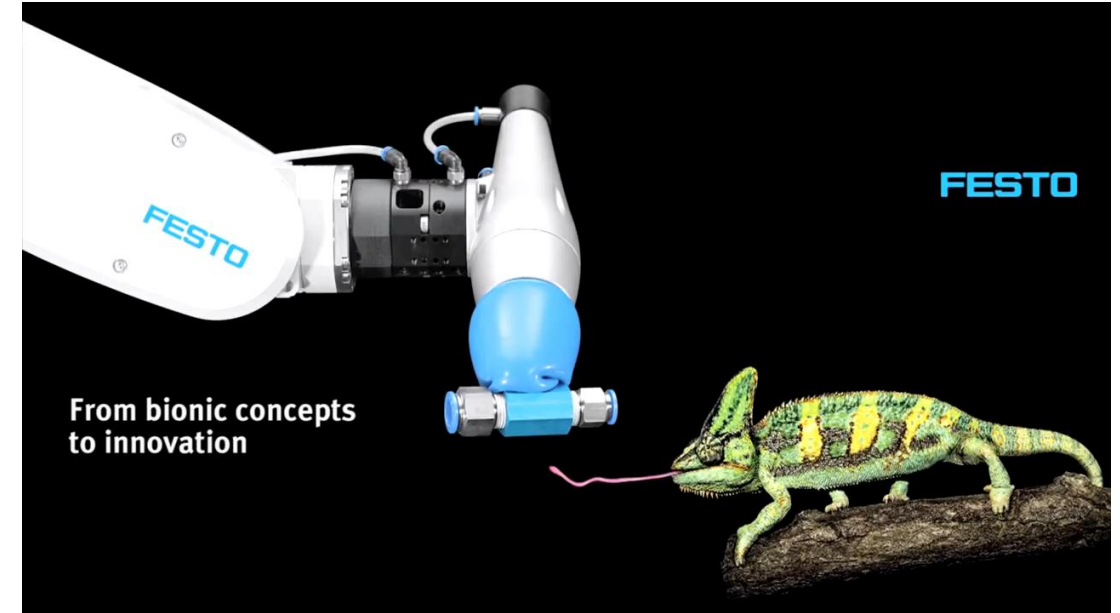


[Shadow Robot](#)

Special/Futuristic End-effector



Festo Grippers: Inspired by nature
Octopus



Festo Grippers: Inspired by nature
Chameleon

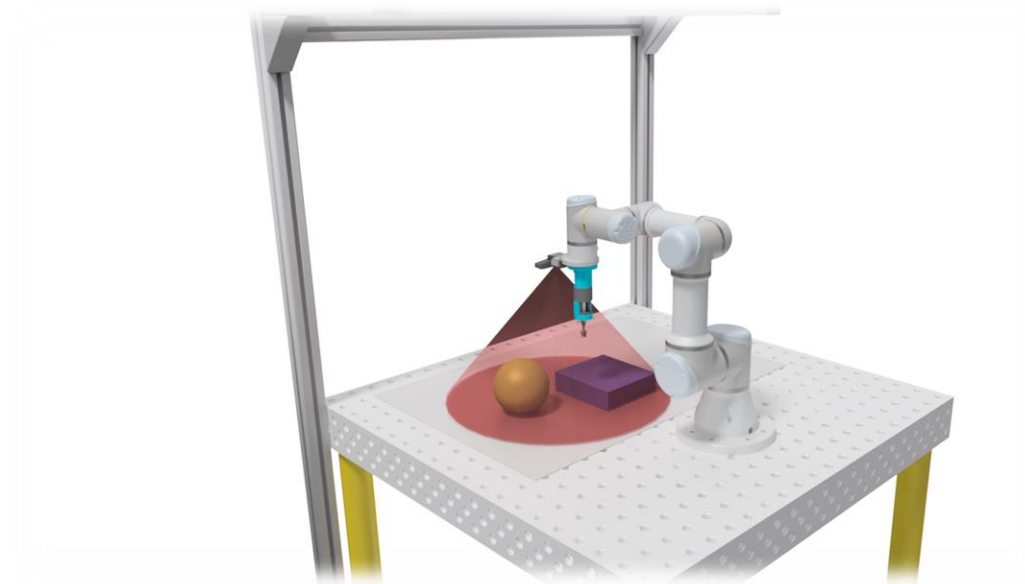
How to choose the right End-effector?

How to choose the right End-effector?

Type of application, object?

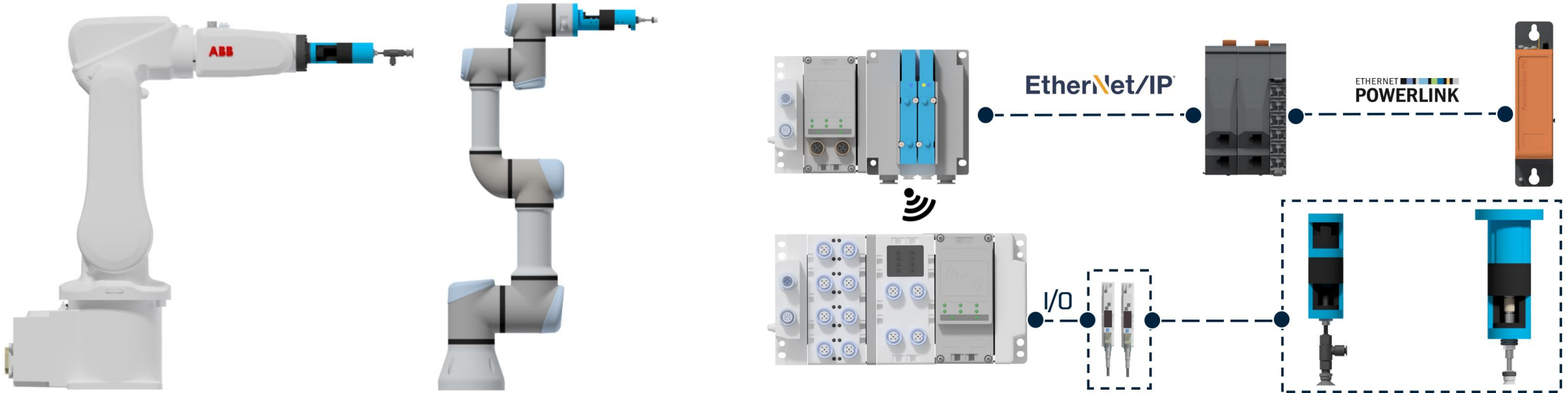
Parameters (working pressure, size and weight, payload, speed, tool lengths, part parameters, space constraints)?

Price?

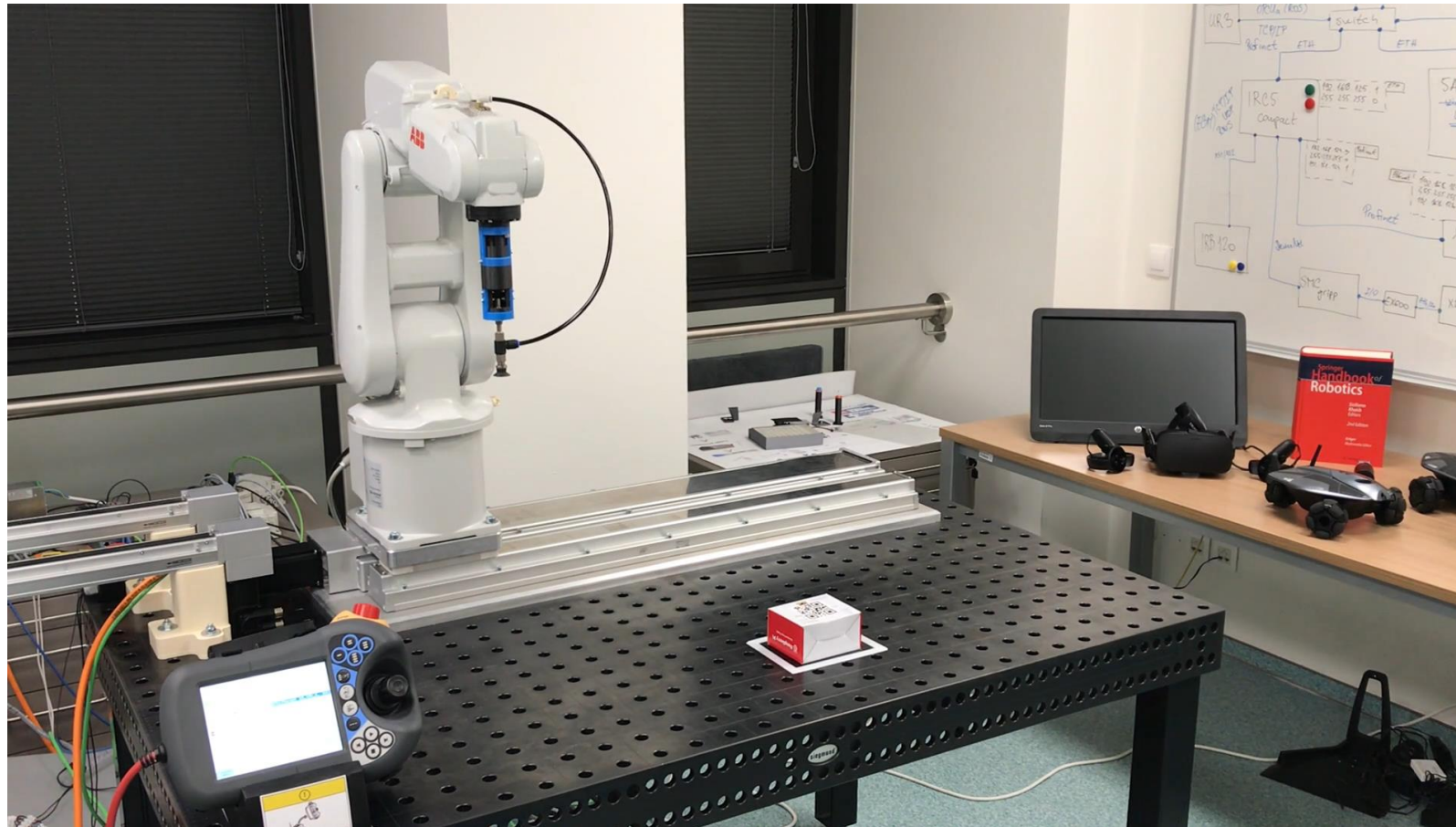


End-effectors – LAB i4C

Vacuum Gripper



Vacuum Gripper

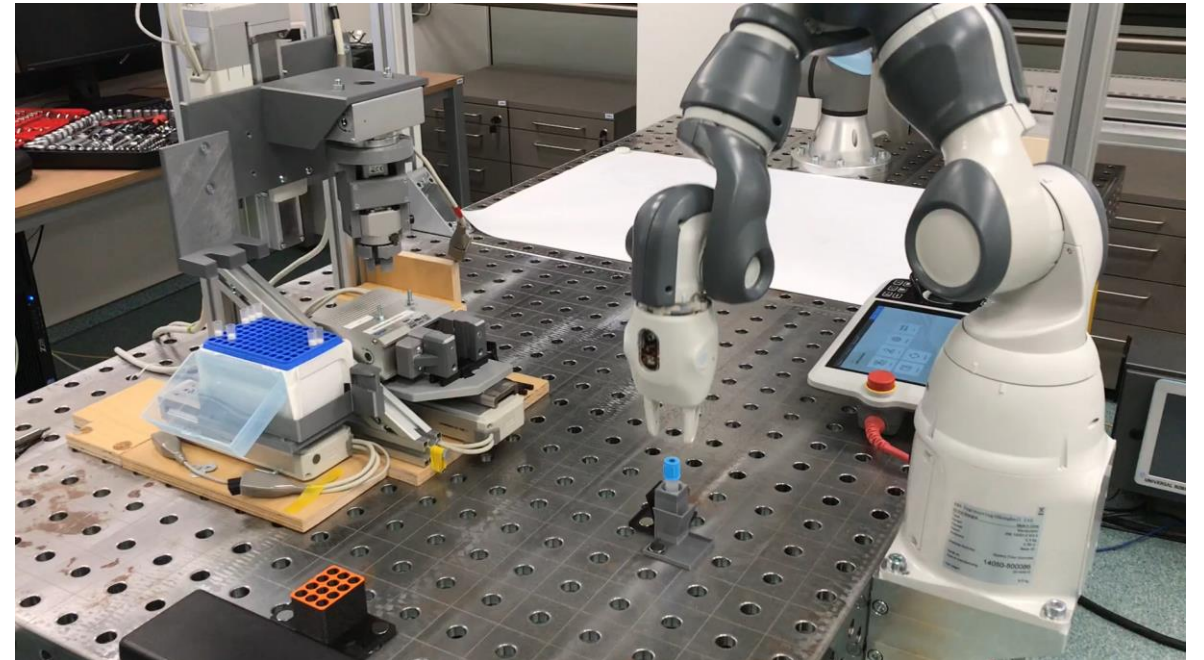
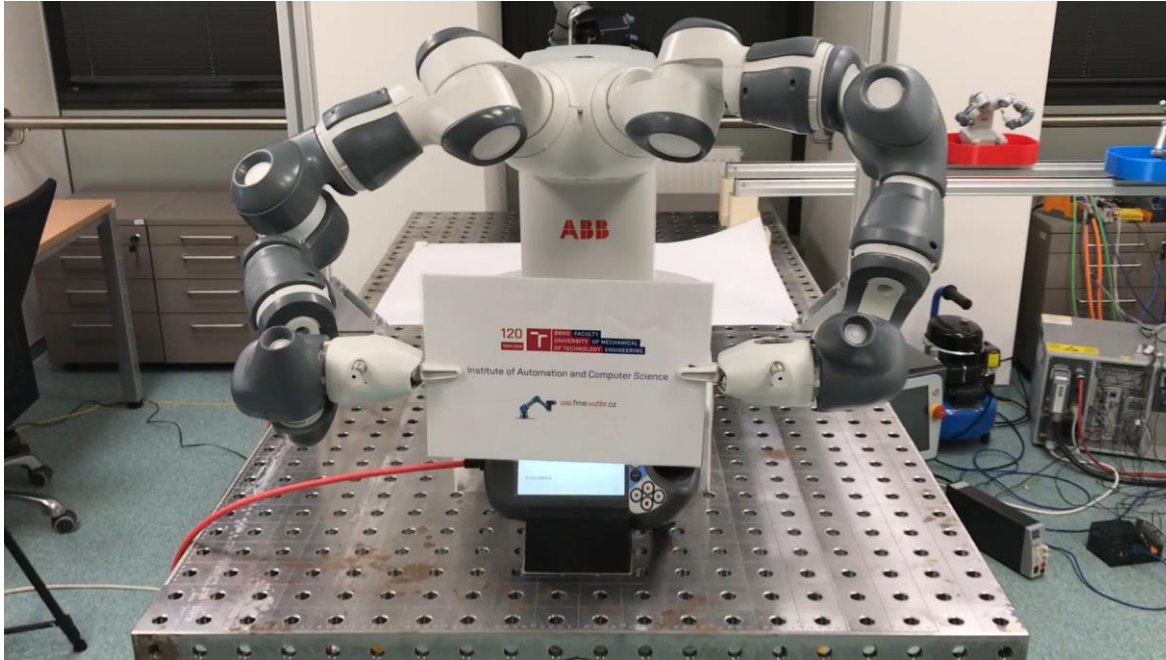


Smart Gripper



[Smart Gripper ABB](#)

Smart Gripper



Special Grippers (OnRobot)



Hex 6 Axis Force Torque Sensor



RG2 Gripper - Flexible 2 Finger Robot Gripper

Special Grippers (Robotiq)

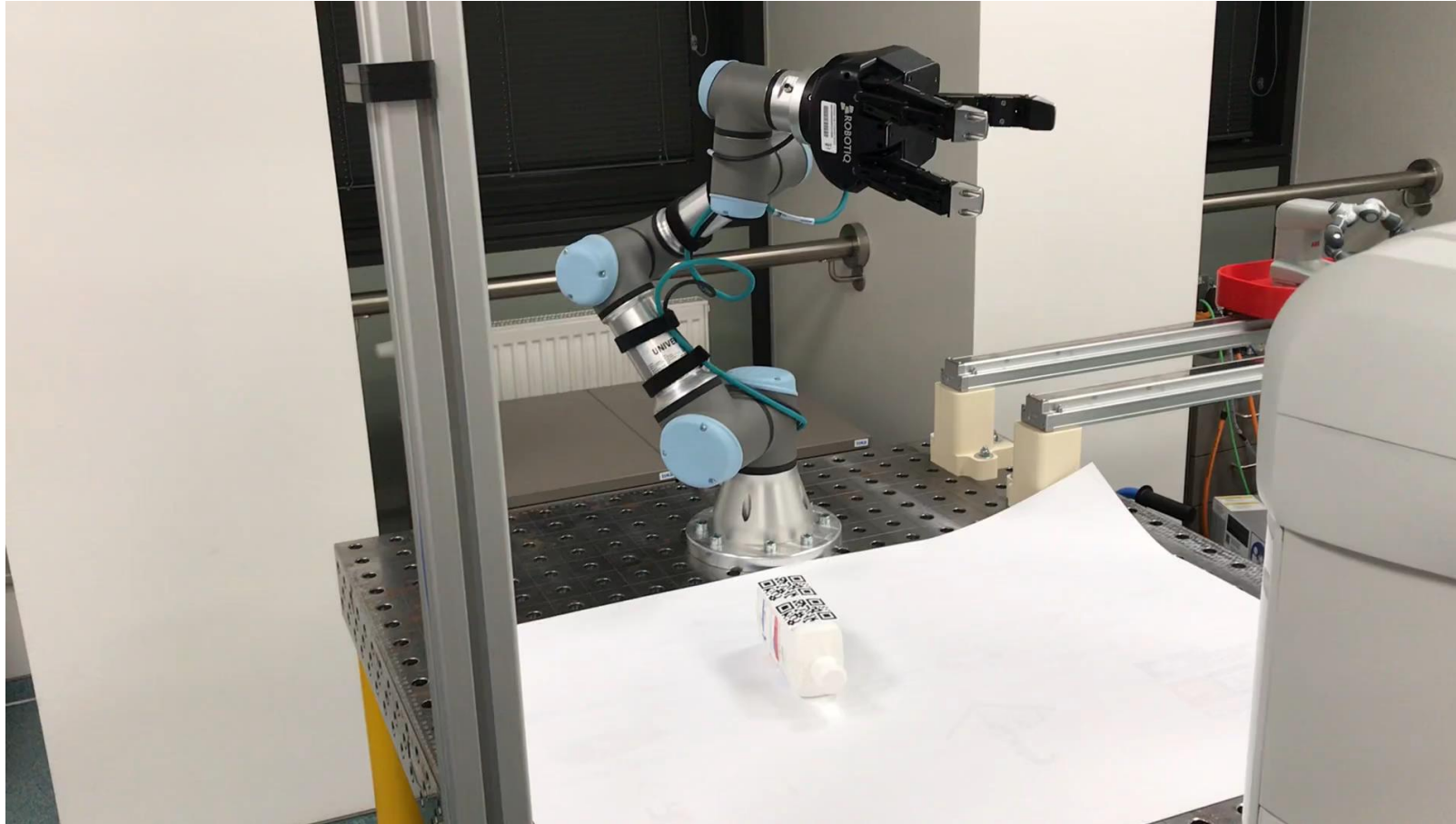


[3-Finger Adaptive Robot Gripper](#)



[2F-140 Robotiq Gripper](#)

Special Grippers (Robotiq)



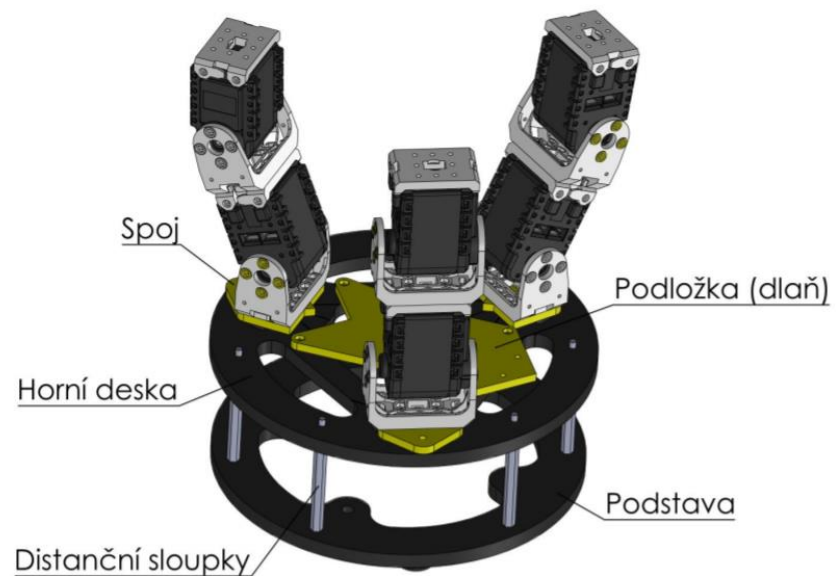
Special Grippers (SMC)



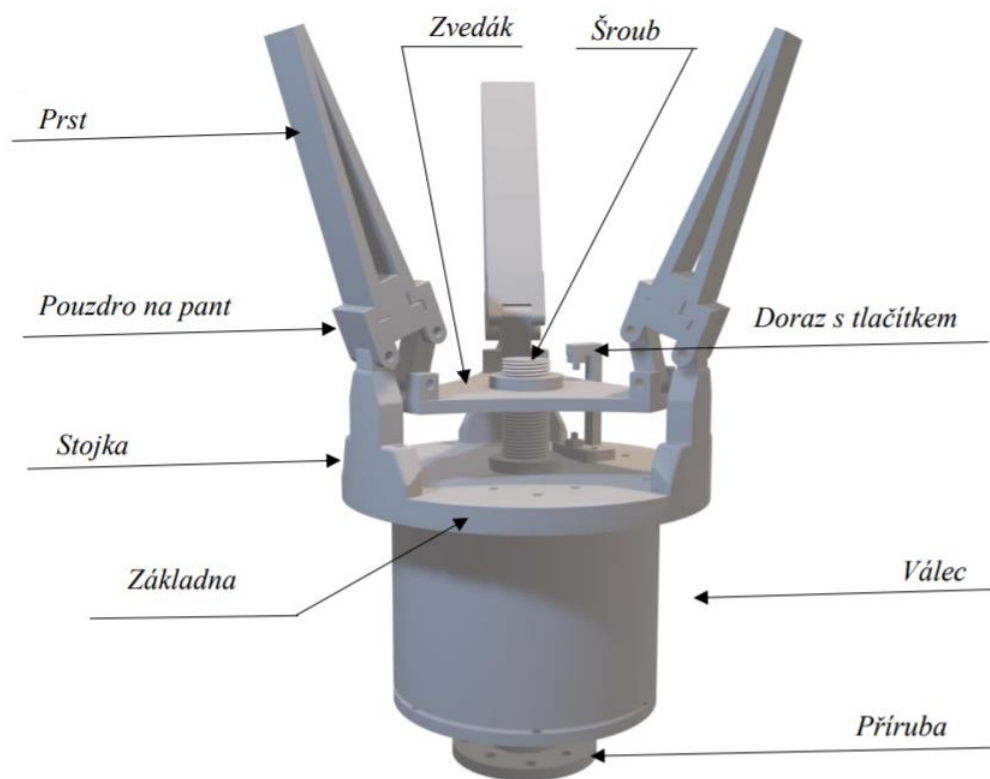
MHM-X6400, Magnetic Gripper



XT661, Cyclone Pad

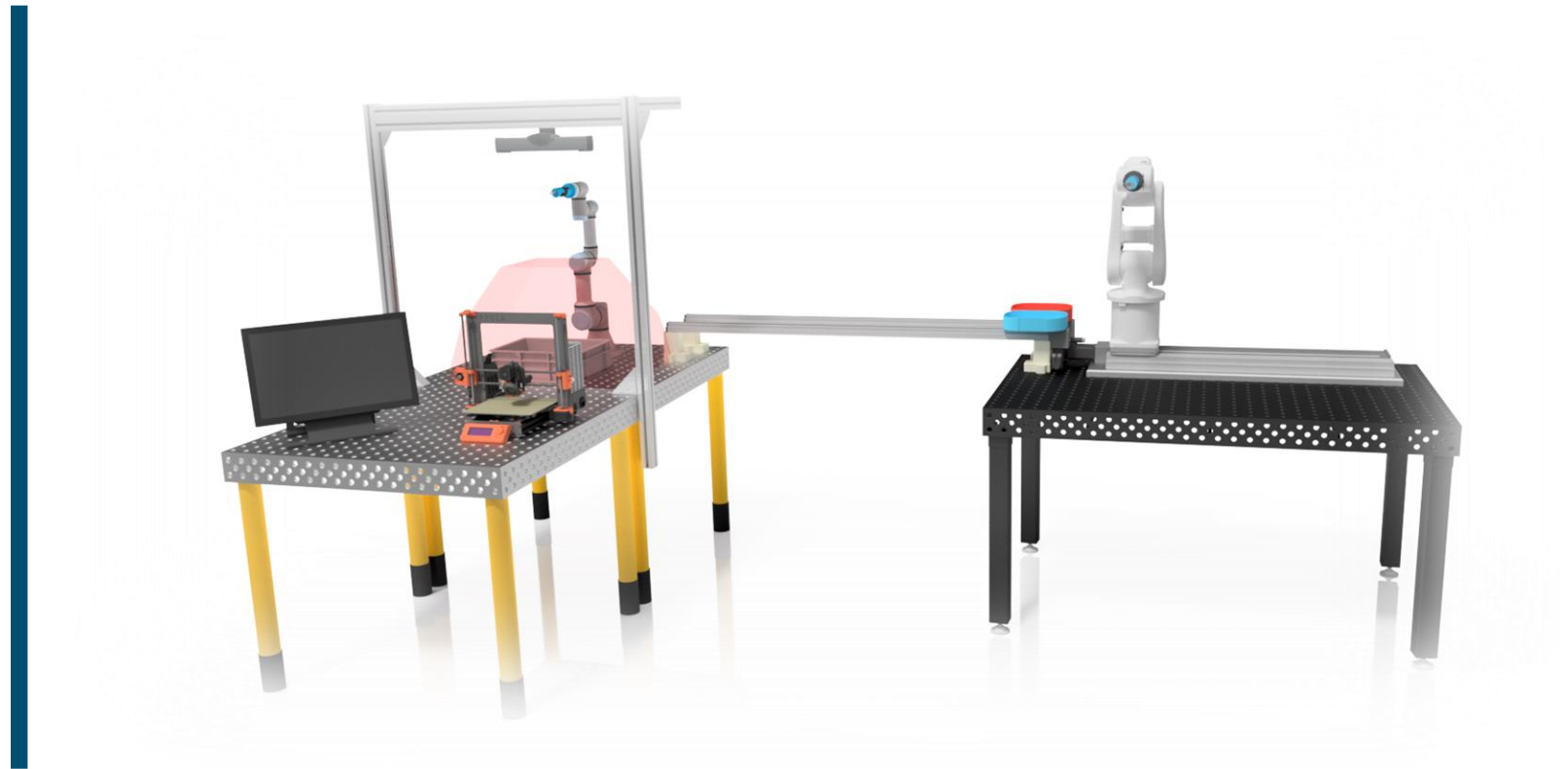


DESIGN OF A ROBOT GRIPPER

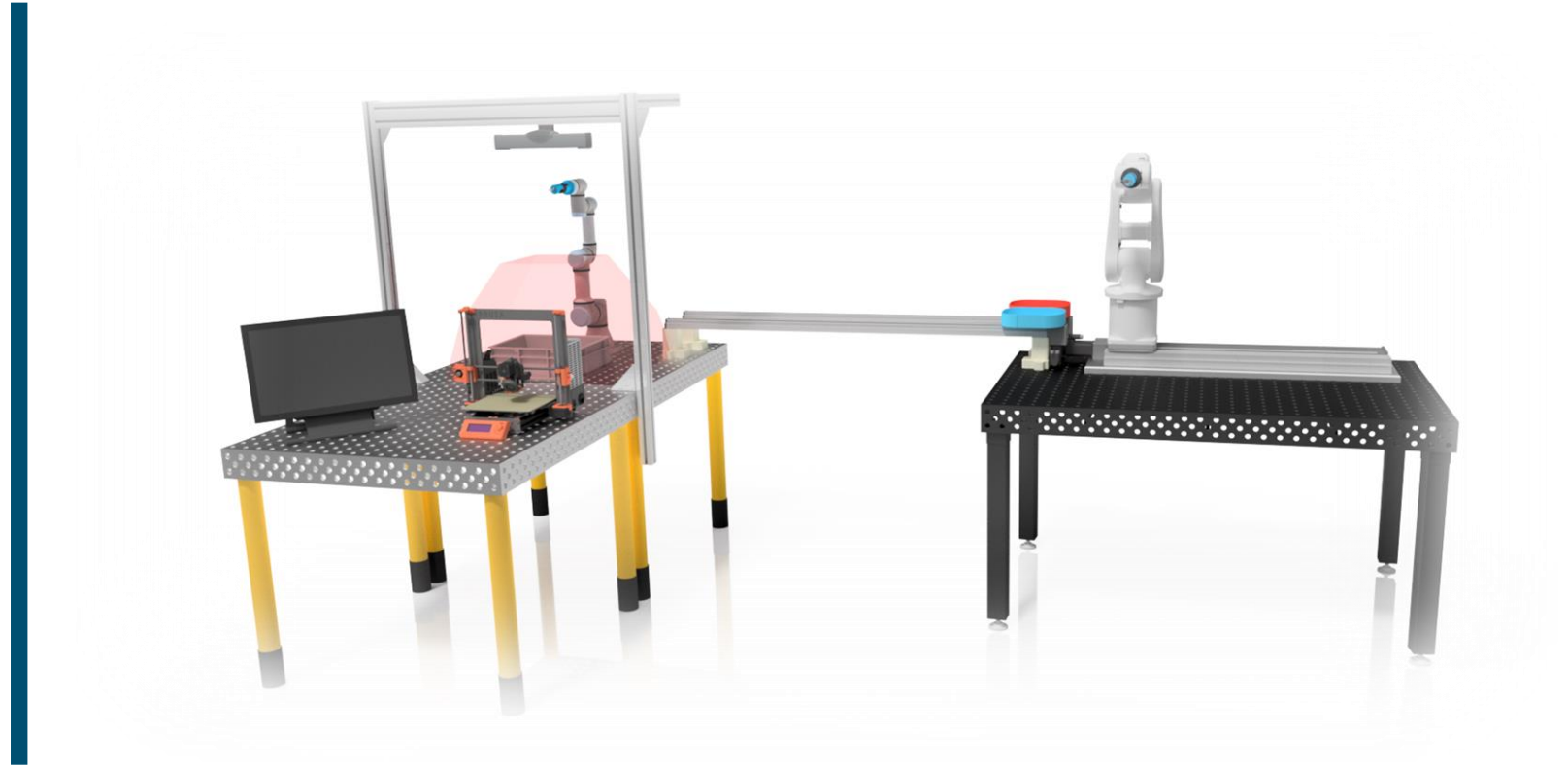


DESIGN OF A ROBOT GRIPPER

Thank You!



Questions?





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