



# Call for Thesis

Cognitive Robotics | 2024



# Introduction

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Industrial Robotics represents the intersection of cutting-edge technology in Computer science, Mechanical and Automation. It addresses critical challenges such as precision, safety, and productivity.

Engaging in research within this domain will provide you with the unique opportunity to solve real-world problems and make a tangible impact on industrial processes.

In the following slides we are going to briefly present the main topics we would like to investigate in collaboration with the universities.

Each proposal is presented with:

- a small introduction;
- candidate background;
- the expected output;
- the expected core benefits;
- some very preliminary references.

The duration of each thesis will be approximately 6/9 months. During this period, every student will be provided with a COMAU badge and account, ensuring access to all the necessary resources for project completion. Finally, the thesis will not be compensated, but free access to the canteen is provided.

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# ROS 2 HW Interface

## Introduction

The purpose of this thesis is to implement a hardware interface for controlling COMAU robots within ROS 2 framework. The Hardware interface will be responsible of establishing the communication between the ROS environment and the robot, enabling the sending and receiving of commands and error handling.

## Candidate background

ROS / ROS 2 - C++ - Multi threaded programming - Linux OS

## Output

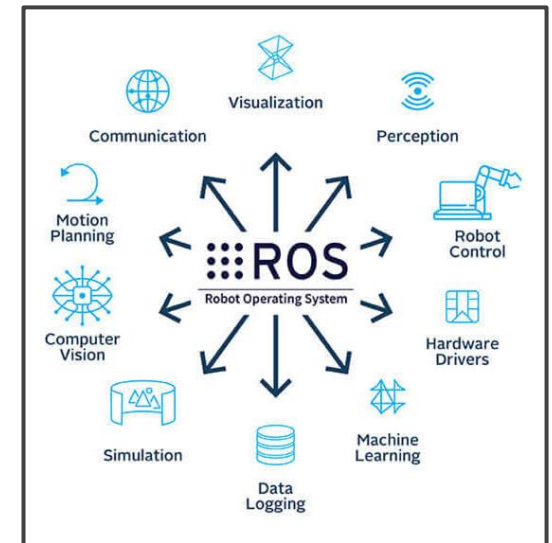
The output is a C++/PDL2 interface, optimized for COMAU manipulators, that fully exploit the benefits coming from ROS 2 (i.e. low latency / robustness / Quality of Service).

## Expected Benefits

The compatibility with ROS 2 will allow to significantly speed up the application development process by leveraging on state of the art robotics libraries, simulation/visualization tools and plug and play hardware components.

## References

- [ROS 2 Control](#)



# AI-Based Gripper Generation

## Introduction

Many industrial applications rely on task-specific gripper designs to ensure the system's robustness and accuracy. However, the process of manual hardware design is both costly and time-consuming. The ideal candidate is expected to have a background with Python, Artificial Intelligence and CAD/CAM.

## Input

3D drawing of the object to be manipulated.

## Output

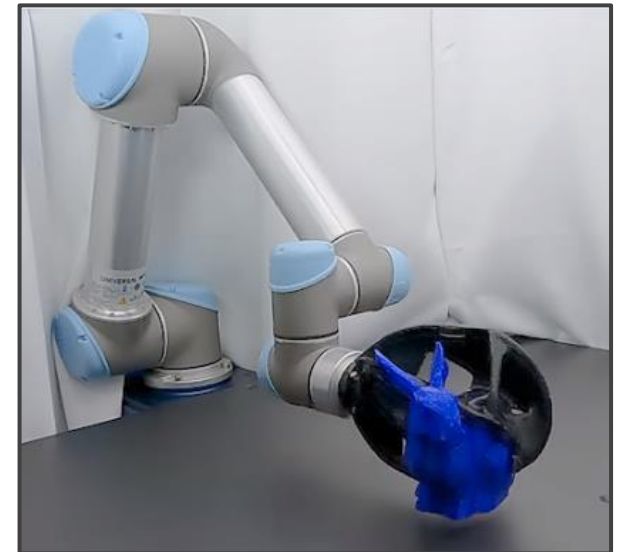
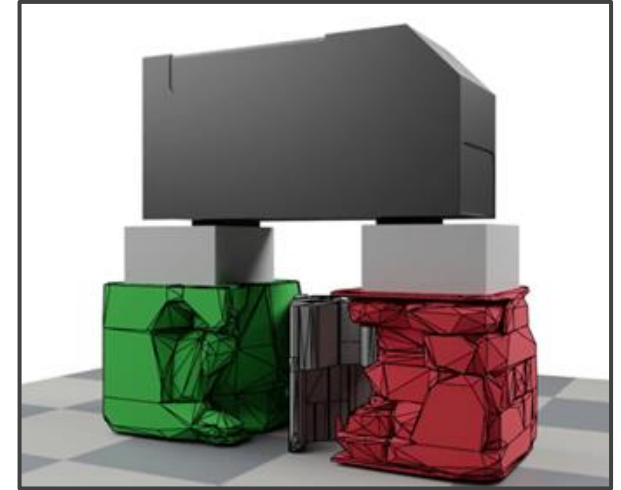
A point cloud that models the gripper extremity.

## Expected Benefits

Reducing the manual work to design simple object (green and red objects on the image) to manipulate "simple" items.

## References

- <https://fit2form.cs.columbia.edu>
- <https://homes.cs.washington.edu/~milink/passive-gripper>



# Depth SuperResolution

## Introduction

This technique aims to reconstruct high-resolution depth map from low-resolution observation(s). These kind of acquisitions can be obtained from cheap or noisy / sparse sensors. The ideal candidate is expected to have a background with Python and Artificial Intelligence.

## Input

Low resolution / quality depth map (missing or very noisy data).

## Output

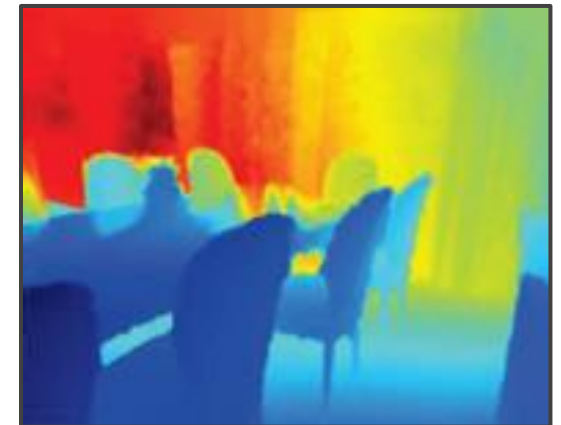
High quality depth map (holes removed and data consistency enhanced).

## Expected Benefits

The main expected benefit is related to the possibility to use low-end cameras without losing accuracy.

## References

- <https://openaccess.thecvf.com/content/CVPR2021/heetal.pdf>
- <https://paperswithcode.com/task/depth-map-super-resolution/codeless>
- <https://arxiv.org/abs/2303.09307>
- <https://github.com/zhwzhong/Guided-Depth-Map-Super-resolution-A-Survey>



# Virtual Reality to show Products and Services

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## Introduction

Virtual Reality (VR) revolutionizes experiences by immersing users in computer-generated environments. It can be extremely beneficial for training in fields like robotics, offering risk-free simulations. Moreover, it can serve as a tool to showcase product characteristics without the need to relocate interested individuals or the machinery. Expanding on this concept, even a production line can be, at least partially, reviewed in these kinds of environments.

## Input

A CAD of a complex machine

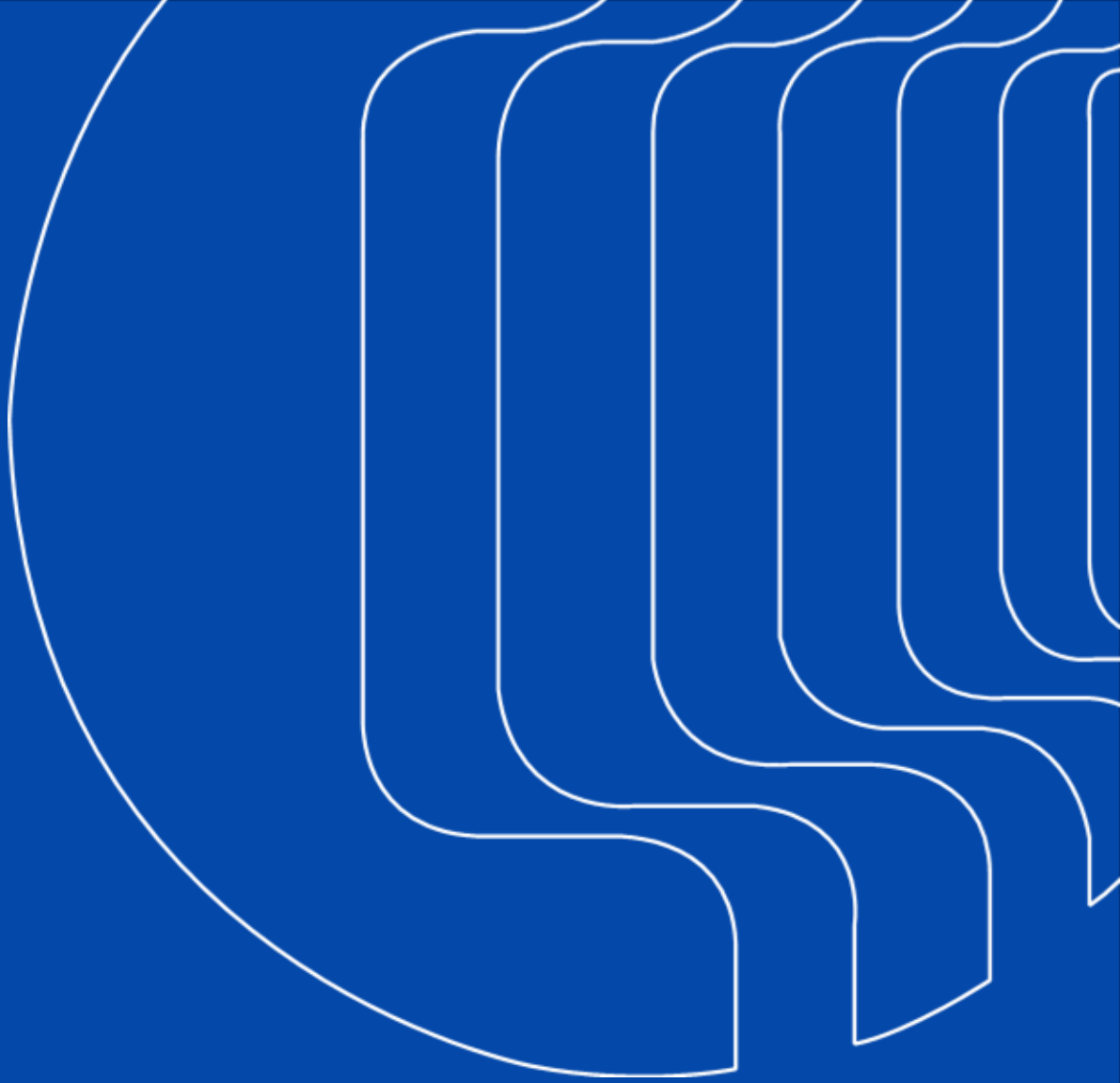
## Output

A virtual environment in which an user can navigate, see, and interact with the machine.

## Expected Benefits

Possibility to see and interact in a realistic (virtual) environment with complex machines without the need to physically move them.





A brand of  STELLANTIS