Towards an optimal method for teaching industrial assembly tasks using collaborative robots: teleoperation vs kinesthetic

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Summary

- **Motivations**: within the industry 4.0, collaborative robot with advanced features, more flexibility and safety, are increasingly exploited in production plants. But their use requires new reprogramming techniques, such as kinesthetic and teleoperation.

- **Goals**: this work propose a new teleoperation mode for teaching assembly tasks. Instead, with an user experiment, it wants to highlight the differences between the two modalities for teaching assembly tasks.

Some research questions can be done:

- Which mode is preferred for ease of use?
- The two proposed approaches are said to be intuitive, but how much when they are used for assembly tasks in industry?
- There is a correlation between physical characteristics of the users and kinesthetic teaching?
- Users who have familiarity with the pad are better with teleoperation teaching?

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Introduction

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Actually, in automotive industry, welding and painting tasks are already highly automated.

Instead, assembly tasks in industry are mainly performed manually today.

For those tasks that are performed by robots, the default modality for teaching assembly tasks is kinesthetic teaching.

Using a collaborative robot such as KUKA LBR IIWA and kinesthetic teaching doesn't allow us to fully use the collaborative features.

Introduction

For these reasons, and inspired by other works, a new modality for teaching assembly tasks was implemented.

Teleoperation teaching, provides a way to control robot using a **PS4 pad**, that allows us to have more control options.

It allows to have a safe remote control of the robot through the use of buttons and analogs. It also have a force feedback features, based on the vibration of the pad.

Introduction

This video shows how the pad is used to perform the task.

Experimental design

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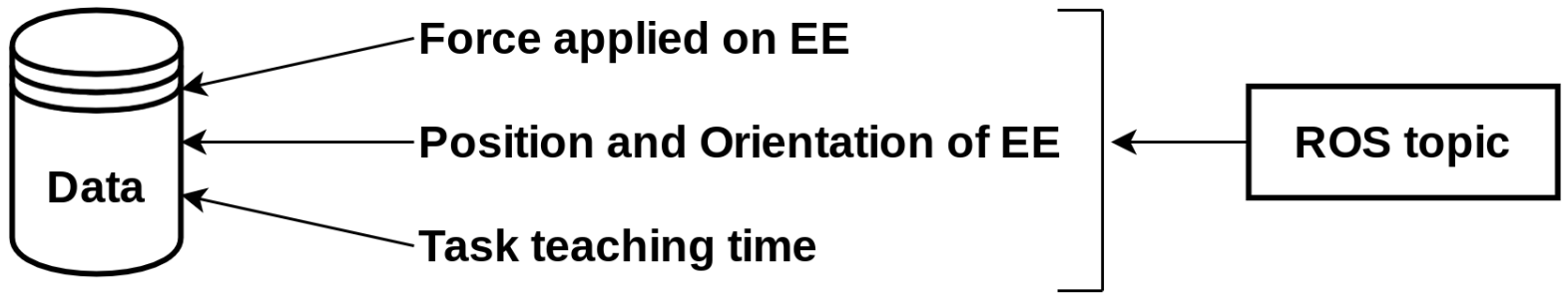
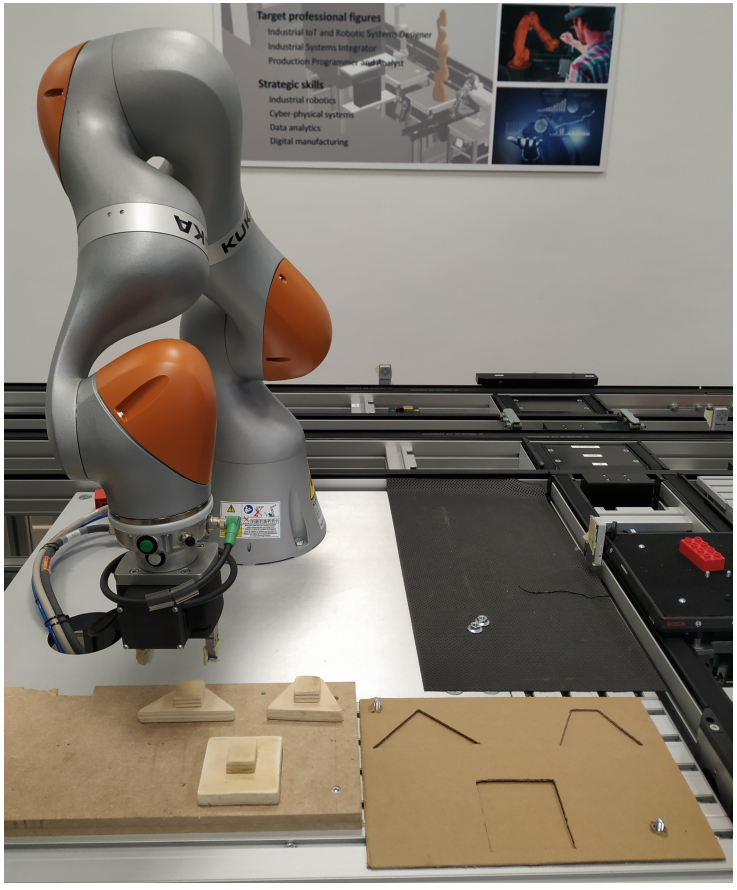
Before the experiment, users were asked to take confidence with both the modalities. Every user perform this phase without seeing other users do the same.

The experiment consists in two tasks in ascending order of difficulty repeated for three times. These tasks were repeated in kinesthetic and teleoperation and the users were rated with the data collected.

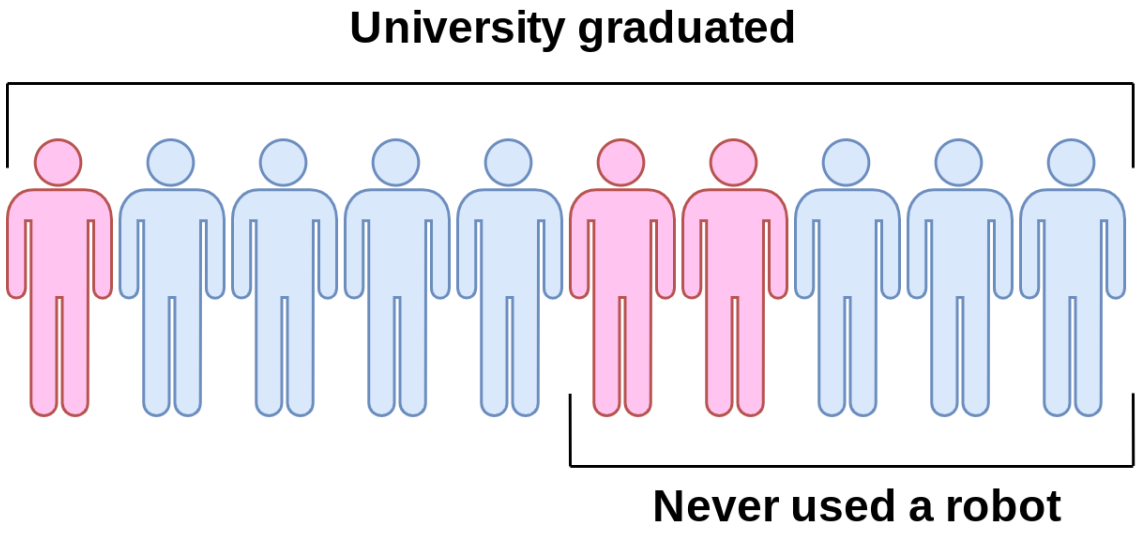


Experimental design

In this figure the setup overview: the KUKA LBR IIWA and on the left the shapes used for the tasks, and on the right the first task.



Experimental design



To obtain better and diversified results among the participants, half of them started with teleoperation teaching, the other with kinesthetic teaching.

Results discussion

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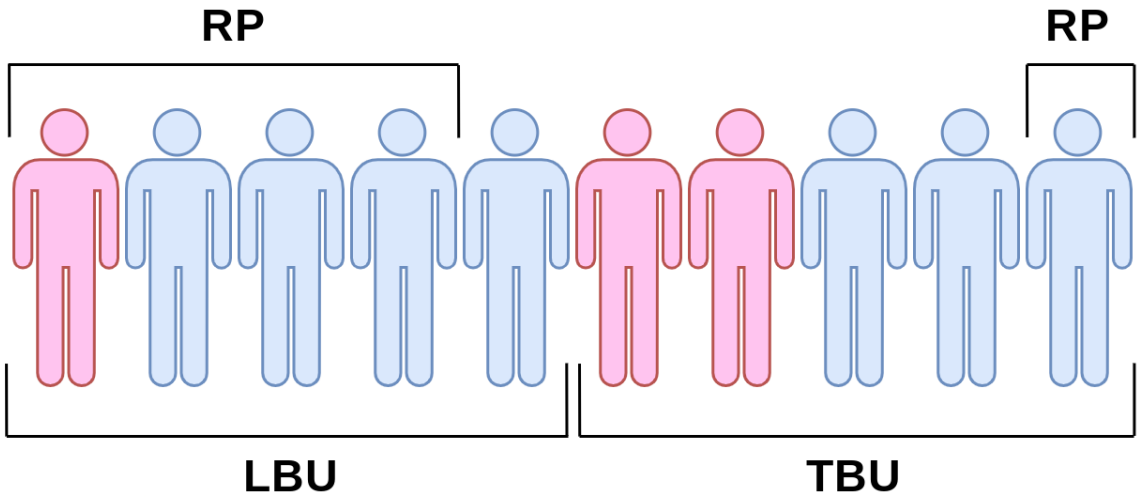
For reasons of time, only two of the research questions, the most important ones, are demonstrated through data. For a more complete and in-depth explanation of everything, refer to the thesis.

For the analysis the users were divided into groups and their characteristics were analyzed.



Results discussion

There is a correlation between physical characteristics of the users and kinesthetic teaching?

Results discussion

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Users who have familiarity with the pad are better with teleoperation teaching?

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Conclusions

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Thank you for your interest and attention.