# Robotic Assembly of Emergency Stop Buttons

Stolt, Andreas; Linderoth, Magnus; Robertsson, Anders; Johansson, Rolf

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# Robotic Assembly of Emergency Stop Buttons

Andreas Stolt, Magnus Linderoth, Anders Robertsson, Rolf Johansson

*Abstract*— **Industrial robots are usually position controlled, which requires high accuracy of the robot and the workcell. Some tasks, such as assembly, are difficult to achieve by only using position sensing. This work presents a framework for robotic assembly, where a standard position-based robot program is integrated with an external controller performing force-controlled skills. The framework is used to assemble emergency stop buttons that were tailored to be assembled by humans.**

## I. INTRODUCTION

The traditional way of programming industrial robots is using position control, i.e., following desired trajectories. Modern industrial robots are very good at this, and perform these tasks very fast with high precision. For tasks where physical interaction between the robot and the environment is essential, using position control only is difficult. The reason is that the locations of all involved objects have to be known with a high accuracy, which is hard to achieve. An example of such a task is assembly, where part variations and uncertain gripping are inherent uncertainties that may cause trouble for a position-controlled implementation.

A way to accomplish assembly tasks is to introduce additional sensing. A force sensor will for instance give the robot the capability to sense contact forces and hence correct for position errors. Incorporating additional sensors makes the task specification more difficult and more complex than just specifying target positions.

Our work has been about accomplishing a complex assembly task, namely the assembly of emergency stop buttons. The scenario contains a number of different operations, some of which can be performed using position control, such as picking the different parts, while others need to be force controlled, such as the attachment of the red button to the yellow box by screwing a nut. The contribution of our work is in the integration of a standard robot program with externally performed force control for a realistic scenario tailored for human assembly. The robot system used in the assembly scenario is the ABB FRIDA [2], see Fig. 1. It is a dual-arm manipulator, where each of the two arms is redundant with 7 degrees of freedom. The robot is controlled with the IRC5 control system. It has been extended with an open control system [1], which makes it possible to modify the references for the low-level joint control loops.

Andreas Stolt, andreas.stolt@control.lth.se, Magnus Linderoth, Anders Robertsson, and Rolf Johansson are with the Department of Automatic Control, LTH, Lund University, Sweden.

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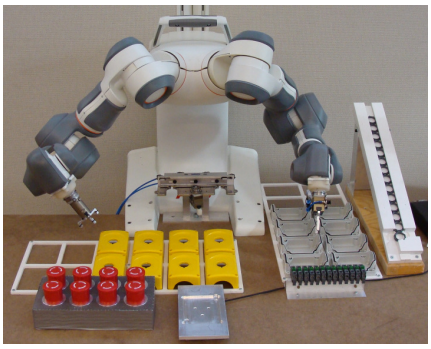

Fig. 1. The FRIDA robot used in the assembly scenario.

## II. FRAMEWORK

The framework used for accomplishing the assembly task was an integration of a standard position-based robot program, with an external controller performing sub-tasks, or skills, using force control. The framework for the force-controlled parts was earlier presented in [4]. All operations that could be position controlled were performed by the native robot controller, and the execution was handed over to the external controller whenever force control was needed.

Most force-controlled operations were performed by using a force sensor mounted beneath the fixture in front of the robot. The screwing of the nut, however, had to be performed in a dual-arm setting, and as there were no force sensors available on the robot, the forces were estimated from the motor currents in this part of the assembly [3].

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