



LUND UNIVERSITY

Robotic Assembly of Emergency Stop Buttons

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

Published in:

Proc. 2013 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2013)

2013

[Link to publication](#)

Citation for published version (APA):

Stolt, A., Linderöth, M., Robertsson, A., & Johansson, R. (2013). Robotic Assembly of Emergency Stop Buttons. In *Proc. 2013 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2013)* (pp. 2081-2081). (2013 IEEE/RSJ International Conference on Intelligent Robots and Systems).
<http://www.youtube.com/watch?v=7JgdbFW5mEg>

Total number of authors:

4

General rights

Unless other specific re-use rights are stated the following general rights apply:

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

Read more about Creative commons licenses: <https://creativecommons.org/licenses/>

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00

Robotic Assembly of Emergency Stop Buttons

Andreas Stolt, Magnus Linderöth, 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

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

The research leading to these results has received funding from the European Community's Seventh Framework Programme FP7/2007-2013 – Challenge 2 – Cognitive Systems, Interaction, Robotics – under grant agreement No 230902 - ROSETTA. This document reflects only the author's views and the European Community is not liable for any use that may be made of the information contained herein.

The authors are members of the LCCC Linnaeus Center and the eLLIIT Excellence Center at Lund University.

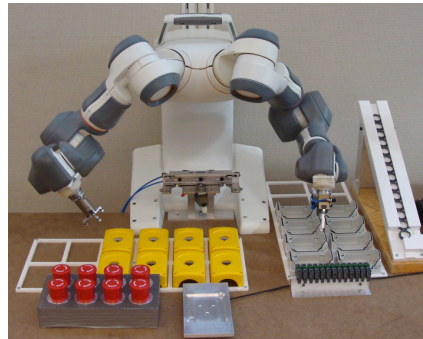


Fig. 1. The FRIDA robot used in the assembly scenario.

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.

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].

REFERENCES

- [1] A. Blomdell, G. Bolmsjö, T. Brogårdh, P. Cederberg, M. Isaksson, R. Johansson, M. Haage, K. Nilsson, M. Olsson, T. Olsson, A. Robertsson, and J. Wang. Extending an industrial robot controller—Implementation and applications of a fast open sensor interface. *IEEE Robotics & Automation Magazine*, 12(3):85–94, September 2005.
- [2] S. Kock, T. Vittor, B. Matthias, H. Jerregård, M. Källman, I. Lundberg, R. Mellander, and M. Hedelind. Robot concept for scalable, flexible assembly automation: A technology study on a harmless dual-armed robot. In *Proc. IEEE Int. Symp. Assembly and Manufacturing (ISAM)*, pages 1–5, Tampere, Finland, May 2011.
- [3] M. Linderöth, A. Stolt, A. Robertsson, and R. Johansson. Robotic force estimation using motor torques and modeling of low velocity friction disturbances. In *Proc. Int. Conf. Intelligent Robots and Systems (IROS)*, Tokyo, Japan, November 2013.
- [4] A. Stolt, M. Linderöth, A. Robertsson, and R. Johansson. Force controlled assembly of emergency stop button. In *Proc. Int. Conf. Robotics and Automation (ICRA)*, pages 3751–3756, Shanghai, China, May 2011.