Implementation of a Cobotic Assembly Process for Integrated Automation of Machine Modules

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Industrial partner: Rollomatic SA, Le Landeron

Rollomatic SA produces high-quality CNC grinding machines. The assembly and verification process of these machines is based on lean manufacturing principles and is mostly manual. The different machine models are built from modules. Some of the modules are equal between machines. Due to the difficulty in finding qualified labor and high costs, Rollomatic would like to study the integration of automatic or partially automatic processes in the manual assembly.

Introduction

In previous studies, subassemblies of the grinding machine GrindSmart 630XW as well as the tool palettes have been analyzed. The tool palettes are used to store cylindrical tools in Rollomatic machines (Fig. 1). They were identified as the most promising candidates for automatic assembly. There are about fifty different palettes produced each year. The aim of this work is to implement a robotic system to assemble all the palettes.

Concept

A concept was defined based on analysis and testing of palette assembly. This involves stacking the first elements of the palette using a guide, then fliping the palette to stack the last elements and tight the 4 corner screws. Flipping is needed for the robot to access both palette faces. This concept requires two grippers and a screwdriver, 31 pick-and-place operations and seven tool changes per assembly.

Implementation

Assembly tests were carried out to verify the concept. The insertion tolerance can be as low as 0.01 mm, making the task difficult for a robot. Algorithms, such as impedance or admittance control, can be used to command the robot's joint torque in relation to external contact forces. These control techniques are interesting for many Rollomatic assembly operations since pick-and-place and screwtightening are the most recurrent tasks. As Rollomatic selected an Omron TM-5 robot, which only accepts joint position commands, these algorithms cannot be used.
A palette assembly cell was implemented using only robot motion control (Fig. 2), which then required several specialized jigs.

Results and Outlook

Tests on the built cell verified the assembly concept. The cell's capacity and autonomy can be increased by adding more part-feeding supports. Impedance control would be particularly useful for inserting pins, where tolerances are tight. Admittance control would help assemble the plates, as a given trajectory must be followed for insertion.
Future work shall analyze other Rollomatic assemblies and determine whether these algorithms can facilitate automation to justify acquisition of a robot that allows torque control.

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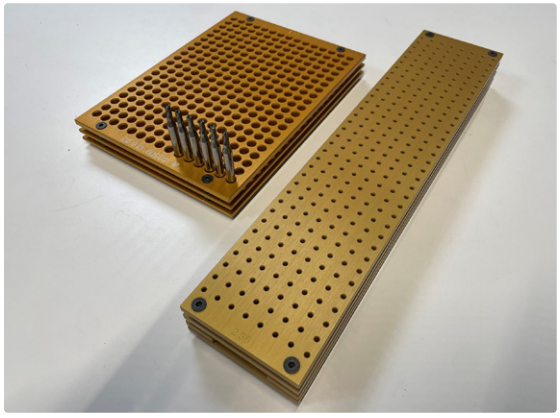

Figure 1: Tool palettes

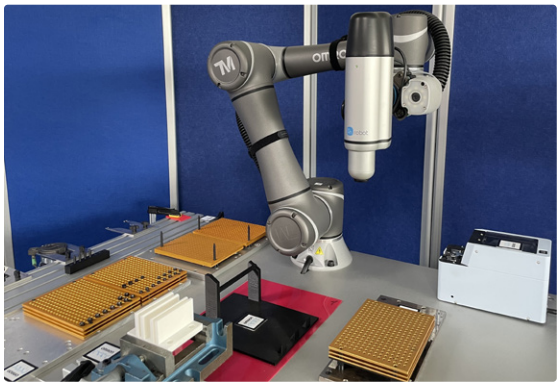

Figure 2: Developed assembly cell