Power Tool Accessory Testing and Quality Control with a Cobotic Cell

Degree programme: BSc in Micro- and Medical Technology
Specialisation: Robotics
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Scintilla AG – a member of the Bosch Group – carries out quality control tests on power tool accessories like screwdriver or drill bits, brushes and more. This thesis presents a Cobotic cell prototype designed to automate and improve these tests under realistic conditions using a 7-axis collaborative robot.

Introduction

Scintilla AG is part of the Bosch Group's Power Tools division. As a leading manufacturer of accessories for hand-held power tools, Scintilla AG conducts performance and quality tests on these accessories. However, current procedures rely on idealized scenarios or repetitive manual tasks, limiting their ability to fully reflect real-world usage. To overcome these limitations, the company seeks to diversify its testing methods through a more flexible solution.

Objective

Develop a modular Cobotic cell for automated testing of hand-held power tool accessories under realistic usage conditions. The system shall capture human-like gestures via a teaching procedure, while ensuring repeatability and data accuracy. Pre-programmed test scenarios shall be available with various control parameters like linear force, tool speed, etc. The robot shall reproduce deviations learned by the operator. Calibration, safety, and ergonomic aspects shall be integrated into the system. A functional prototype shall validate the concept.

Methods

The Cobotic test cell uses a 7-axis Kassow KR1410 Cobot. A common tool holder was designed and prototyped to accommodate various power tools and hold them firmly. A 3D-printed mold is used for each tool. A flange-mounted Robotiq FT300 sensor measures forces and torques applied by the robot. This feedback is used for control, data logging, and anomaly detection. A robot-controlled linear motor system actuates the tool trigger. The software is programmed using C++, data is processed in Python.

Results

Force and torque measurements provide meaningful data to characterize the interaction of the robot between the accessory and the workpiece. Figure 1 shows typical usage. Figure 2 shows forces/torques while drilling on wood. The custom-designed tool holder allows fast and ergonomic tool changes with excellent rigidity. The robot performs the operations taught precisely.

Outlook

Further tasks include optimizing the teaching procedure to have different programmable motion constraints (e.g. tool position and/or orientation). A Bota SensONE force/torque sensor shall be used, allowing better control of the Kassow robot. The data shall be used for further accessory analysis and performance evaluation. Further refinements shall expand test coverage to additional tools and accessories.

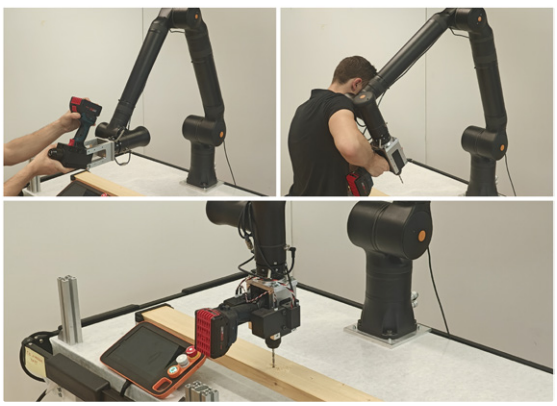

Figure 1: From left to right: Operator mounts a drill driver, teaches how to drill one hole and starts a test scenario.

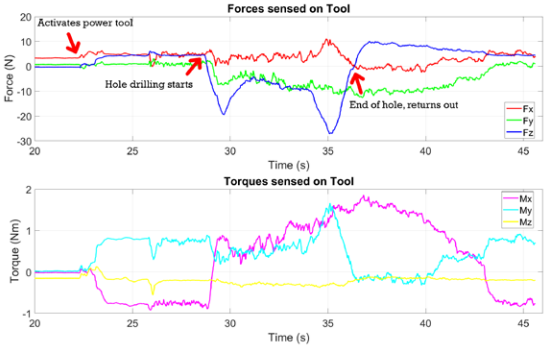

Figure 2: Measured forces and moments applied to a drill bit while drilling a hole on wood.

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