Karlsruhe Institute of Technology

Division III – Mechanical and Electrical Engineering

wbk – Institute of Production Science

AgiProbot – Inspection Station

Initial Inspection of Used Products for Remanufacturing

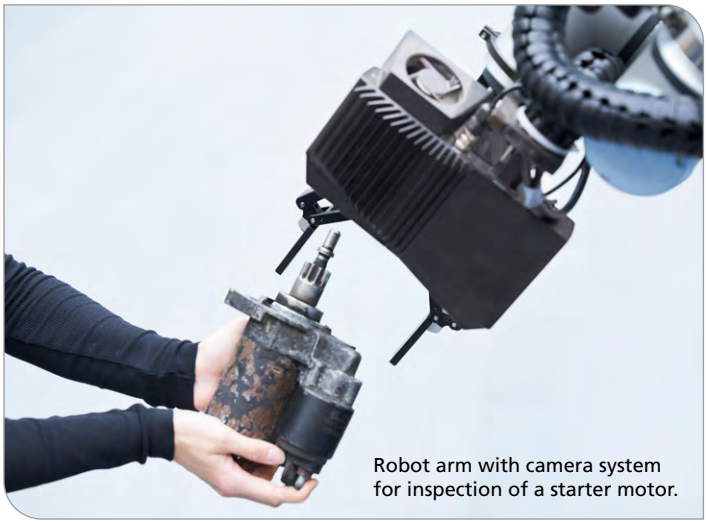
How can a factory autonomously adapt to constantly changing conditions? This question is studied under the research project **AgiProbot – Agile Production System Using Mobile, Learning Robots with Multi-Sensor Technology for Uncertain Product Specifications** of Karlsruhe Institute of Technology (KIT). Remanufacturing represents an ideal use case: An unknown quantity of used products in an unknown quality state are discontinuously returned to the remanufacturing facility. These products are to be disassembled automatically, if possible, and selected components are reprocessed and will be reused in production processes again.

The Remanufacturing Process

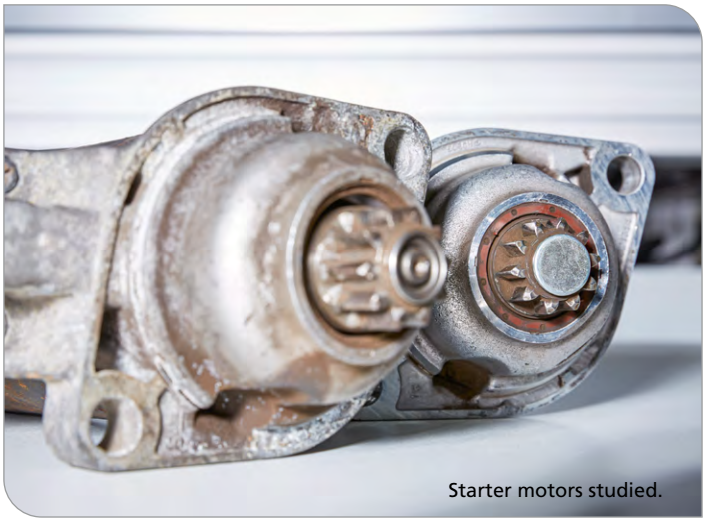
Remanufacturing is an industrial process for the disassembly, reprocessing, and reassembly of **used products** to make their quality reach that of new products, and to enable **reuse**. In this way, remanufacturing contributes to **resource-efficient and sustainable circular economy.**

Inspection Tasks at the Inspection Station

In the early phases of remanufacturing, **inspection tasks** predominate. The state of the returned used products and their components must be determined. Sometimes, strongly damaged **used products** cannot be remanufactured. To save costs, they have to be removed from the process at an early stage. In industry, these tasks are mainly executed by **humans**. However, they can be automated with the help of the inspection station. The major challenge is to cope with the **uncertain** state of the used products. They exhibit a variety of **wear phenomena**, such as deformations, cracks, and corrosion.



Robot arm with camera system for inspection of a starter motor.



Starter motors studied.

Automation of Inspection Tasks

At the inspection station, the used products are subjected to an initial inspection. For this purpose, various optical measurement methods are applied. Among others, a robot-controlled camera system captures **image and geometry data** (so-called point clouds). Thanks to multi-dimensional information channels and appropriate **evaluation algorithms**, defects can be detected reliably. In an uncertain environment (Which product exists? Which defects occur?), the inspection station autonomously learns to develop a strategy for the solution of the inspection task. **Artificial intelligence** methods based on neural networks are used to plan recording positions of the camera system and to evaluate the data obtained.

Inspection station with robot arm and rotary table.

Automatic disassembly is studied at the AgiProbot factory. (Photos: wbk – Institute of Production Science/KIT)

Karlsruhe Institute of Technology (KIT)
wbk – Institute of Production Science
Kaiserstraße 12
76131 Karlsruhe, Germany

Prof. Dr.-Ing. Gisela Lanza
Phone: +49 721 608-44017
Email: gisela.lanza@kit.edu
www.wbk.kit.edu/21_90.php

Jan-Philipp Kaiser, M. Sc.
Phone: +49 1523 9502650
Email: jan-philipp.kaiser@kit.edu
www.wbk.kit.edu/21_3748.php

Karlsruhe Institute of Technology (KIT) · Prof. Dr. Oliver Kraft – Acting President of KIT · Kaiserstraße 12 · 76131 Karlsruhe, Germany