ALBATROSS

Advanced Light-weight BATteRy systems Optimized for fast charging, Safety, and Second-life applications

NEWSLETTER

April 2025

🔋 Advancing Robotic Battery Dismantling 🤖

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This project received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement No 963580- ALBATROSS

🔋 Advancing Robotic Battery Dismantling 🤖

ALBATROSS has developed and validated of a semi-automatic robotic dismantling cell for battery modules. This newsletter details the advancements in the dismantling of battery modules within a semi-autonomous cell, outlining the steps and safety measures implemented to create a secure laboratory environment.

Laboratory Development and Safety Measures 🧪 🦺

Establishing a safe laboratory for Li-ion battery disassembly was challenging due to the lack of comprehensive safety standards. The laboratory was temperature-controlled (20-30°C) and equipped with CO2 and hydrogen sensors linked to a fire alarm and exhaust system to handle gases released during thermal runaway. Safety procedures, restricted access for trained personnel with PPE, and fire management equipment (F500 extinguisher, Bat-safe container) were implemented.

Automatic Dismantling Processes 🤖 🔧

ALBATROSS aims for robotic dismantling of battery modules, starting with a design similar to a Cleantron module. A Human-Machine Interface (HMI) was developed to define and guide both robotic and manual dismantling steps for different modules, allowing operators to indicate operations and their application points and storing step lists for future use.

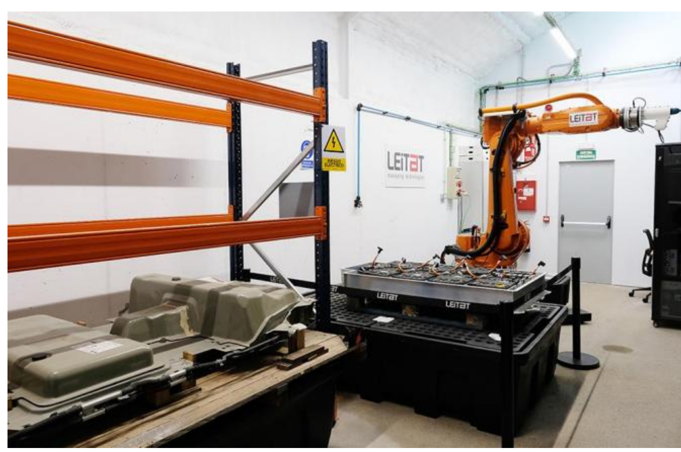

Figure 1. First iteration of the robotic battery dismantling laboratory in LEITAT: storage area (left) and liquid leak collector recipients with the battery assembly on top (right).

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Automatic Unscrewing 🪛 🔩

A key automatic process is the removal of screws of various types and sizes using a single robot. This involves several integrated systems:

- **Screw Detection:** A neural network (Yolo8) is trained to localize screws in an image and determine their type, with a secondary algorithm processing image patches to find the screw center and estimate the cap size. The HMI allows the operator to select screws based on the AI detection or manually define the robot's position if the AI fails.
- **Robot Tool:** An industrial robotic screwdriver and a rigid metallic construction was employed to perform the screwing operation.
- **Robot Programming:** The ROS framework was used to automatize the robot's actions for unscrewing. This involves nodes for camera handling, screw detection and localization, and controlling the robot's movement for unscrewing. Robot-specific safety programs and fine movement capabilities, such as force control, were also implemented.

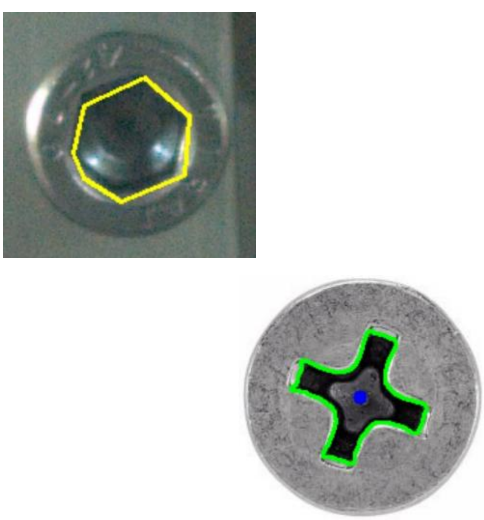

Figure 2. Examples of screw detection.

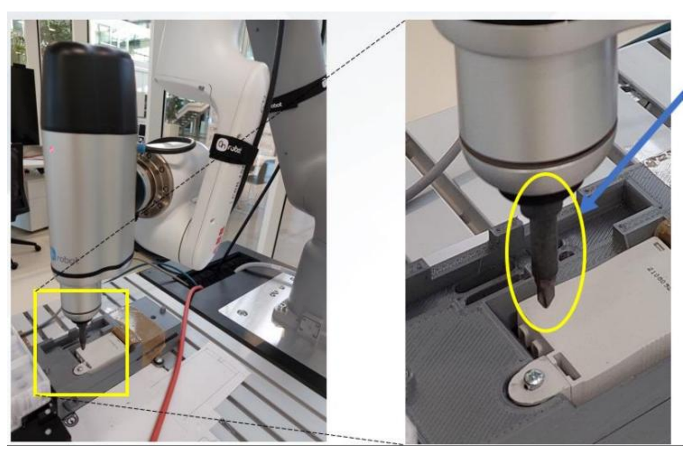

Figure 3. OnRobot collaborative screwdriver. Refer to the 3D printed screwdriver extender designed and manufactured to allow the extraction of screws in narrow zones.

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Spot Welding Removal 🛠️ ⚙️

Tests were conducted using dummy batteries to develop a method for removing spot welds connecting cells within modules while avoiding cell perforation and thermal runaway. Due to difficulties with computer vision detecting welds, human operators selected weld positions via the HMI. Three approaches for weld removal were explored: using a drill bit with a robotic screwdriver, using a drill bit with a milling machine, and using a flat bit with a milling machine.

The screwdriver approach was found to be unreliable. Tests with the milling machine using a drill bit showed that force control caused significant heat and melting, while position control was effective for positive poles but risky for negative ones. Using a flat bit with a milling machine and force control on negative poles resulted in better outcomes but generated high temperatures.

Based on these tests, no single ideal approach was found, although using a milling operation with a drill bit and position control for positive poles was identified as the most promising method as it avoids penetrating the cell.

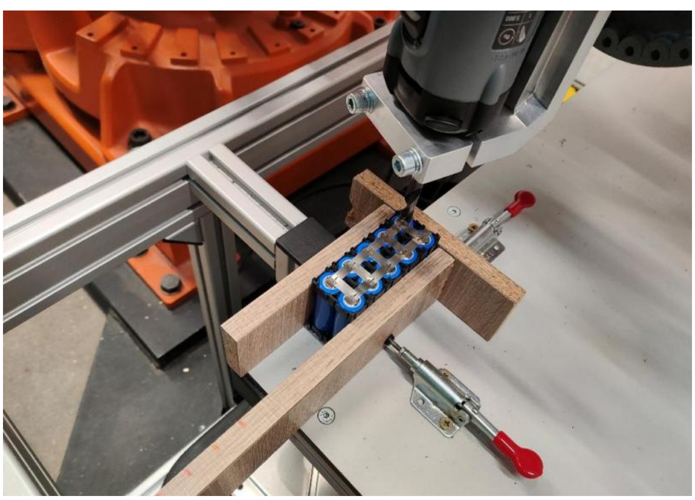

Figure 4. Setup for the dummy cells tests (left) and the respective dummy cells after employing the milling operation with a drill bit and the position control approach (right).

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