Newsletter 9

Safe and Efficient EV Battery Disassembly

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Collaborative Robotics for Safe EV Battery Disassembly - A Key Challenge in the R3-MYDAS Project

The rapid growth of electric mobility is transforming the automotive industry and accelerating the transition towards more sustainable transport systems. At the same time, this transition introduces new challenges for the circular economy—particularly in managing end-of-life electric vehicle (EV) batteries.

Within the **R3-Mydas** project, partners are developing innovative technologies that support circular manufacturing, remanufacturing and recycling of energy-intensive products. One of the key technical challenges addressed is the **safe and efficient dismantling of EV battery packs**, a crucial step in enabling reuse, repurposing and recycling of valuable battery components.

The Complexity of EV Battery Disassembly

EV battery packs are complex systems comprising multiple layers of components, including protective housings, cooling structures, electrical connectors, busbars, modules, and individual cells. Before internal components can be accessed, the battery enclosure typically needs to be opened by removing **dozens or even hundreds of screws**.

Disassembly operations must be performed with extreme care due to several safety risks associated with lithium-ion battery systems:

- **High voltage levels**, often exceeding several hundred volts
- **Risk of thermal runaway** if cells are damaged
- **Chemical hazards** related to electrolyte leakage
- **Mechanical risks** due to heavy battery pack structures

Because of these hazards, many battery dismantling processes are still largely **manual and labour-intensive**. While manual operations provide flexibility, they can expose workers to safety risks and limit scalability as EV volumes increase.

Across Europe, research projects are therefore investigating how robotics can support safer battery dismantling. For example, the EU project **RISBAT** explored automated solutions for opening lithium-ion battery packs, focusing on reducing hazardous manual tasks in recycling environments. Other initiatives, such as **RECIRCULATE,** are developing AI-supported robotic systems capable of dismantling battery packs into modules and cells. These projects highlight a growing consensus: **robot-assisted disassembly can significantly improve safety and efficiency**, but flexible solutions are required to deal with the wide variation in battery pack designs.

The R3-Mydas project builds on this state of the art by exploring how **advanced mechatronics, digital technologies and collaborative robotics** can support flexible battery disassembly operations.

Precision Screwdriving: A Critical Enabling Technology

One of the most repetitive and time-consuming steps in battery pack dismantling is the removal of threaded fasteners that secure the battery housing and internal modules. A single battery pack may contain **hundreds of screws**, which must be removed in a controlled and reliable manner.

Torque control is particularly important. Applying insufficient torque may prevent screws from loosening effectively, while excessive torque can damage threads, deform casings or cause tools to slip close to sensitive high-voltage components. Maintaining consistent and precise torque, therefore, plays a critical role in both **process efficiency and operational safety**.

Within the R3-Mydas project, **Spin Robotics** contributes expertise in collaborative robotic screwdriving technologies designed for flexible automation environments.

Spin Robotics develops **cobot-compatible screwdriving tools** that integrate directly with collaborative robots and enable automated screw insertion and removal with controlled torque and process monitoring. These systems provide several capabilities that are particularly relevant for battery disassembly tasks:

- Accurate and repeatable **torque-controlled screwdriving**
- **Automated screw feeding and pickup** for continuous operation
- **Digital monitoring and logging** of screwdriving operations
- Safety mechanisms designed for **human-robot collaboration**

Precision screwdriving tools are increasingly recognised as a key component in automated disassembly systems. Several research prototypes and industrial demonstrators developed in recent EU projects rely on robotic screw removal as the first step in battery pack dismantling, confirming the importance of **reliable torque-controlled fastening technologies** in circular battery processing.

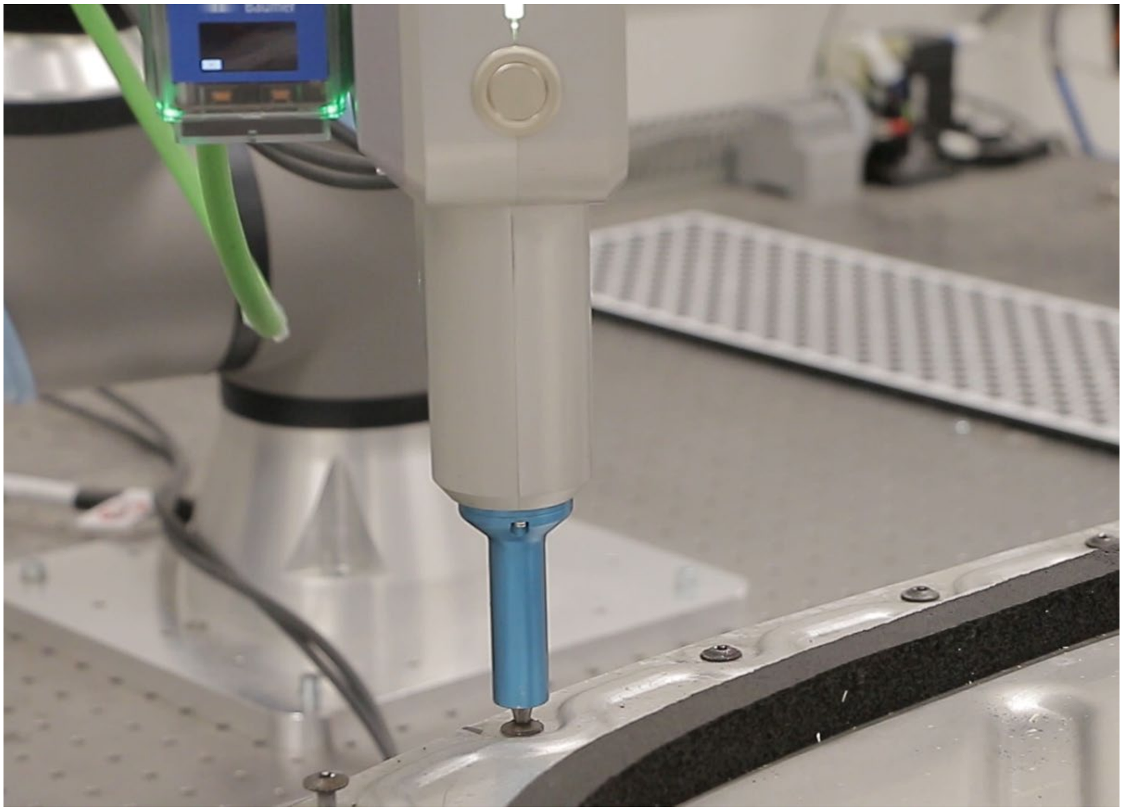

Figure 1: Collaborative robotic screwdriver used in R3-Mydas.

Human–Robot Collaboration Instead of Full Automation

Although automation is an important goal for battery recycling, the current stage of the EV lifecycle presents a practical challenge. While EV adoption is increasing rapidly, the number of end-of-life battery packs available for recycling remains relatively limited and battery designs vary widely between manufacturers.

Because of this variability, fully automated disassembly lines can struggle to achieve economic viability. For this reason, many recent research initiatives are focusing on **flexible robotic workcells rather than fixed automation lines**.

Collaborative robotics offers an effective intermediate solution. Cobots allow humans and robots to work together safely in shared workspaces, combining robotic precision with human adaptability.

In such systems:

- Robots perform repetitive and precision-critical tasks such as screw removal
- Human operators handle inspection, cable routing and complex manipulation
- Flexible robotic workcells can adapt to different battery pack designs

This hybrid approach aligns with the direction explored in several European research initiatives investigating robotic battery dismantling. Studies on collaborative and multi-robot systems show that combining robotic automation with human supervision can significantly improve disassembly efficiency while maintaining the flexibility required for diverse battery architectures.

Supporting the Future Circular Economy of EV Batteries

By combining **precision tooling, collaborative robotics and digital process monitoring**, the R3-Mydas project is helping to develop practical solutions for safer and more efficient EV battery dismantling.

Technologies such as robotic screwdriving systems from Spin Robotics demonstrate how targeted automation can reduce manual workload while maintaining the flexibility required for different battery designs.

As the number of end-of-life EV batteries increases in the coming years, such modular and scalable solutions will play a key role in enabling **economically viable circular value chains for electric vehicle batteries**, supporting Europe's transition towards a more sustainable and resource-efficient mobility ecosystem.