How to lengthen the life of an object of value using hybrid additive technology

Can one fix rare objects and high-value mechanical components? At **Polo Meccatronica**, in Rovereto, with additive manufacturing, one can.

ProM Facility, the prototyping and product development laboratory of Polo Meccatronica in Rovereto, Trento, celebrated its first two years of operation on April 3.

A **milestone** celebrated by the seven technologists and 20 undergraduates, doctoral students and researchers who over the past 12 months have taken turns - in collaboration with companies from different regions of Italy and abroad - in the use, study and industrial design on its machinery for Industry 4.0 worth more than **6 million euros** in total: metal and polymer powder 3D scanners and printers, laser cutting of tubes and sheets, hybrid machine tools for additive and subtractive processing, as well as systems for metrology and quality control and ICT infrastructure.

There are many different sectors of focus, from automotive to biomedical, including the use of hybrid additive technologies to repair worn or damaged objects in favour of the circular economy and environmental sustainability of the mechanical industry.

This aspect was specifically addressed by **Matteo Perini**, a doctoral student at the University of Trento, who worked on the **Dmg Mori Lasertec 65 3D**.

The only one of its kind in Italy, this machine - a 5-axis CNC milling machine - is equipped with a nozzle capable of **depositing metal powder and melting it instantly** thanks to a laser beam.

In doing so, Lasertec can therefore operate according to the principles of **hybrid additive technology**, that is, it is able to both **add** and **remove** material during processing.

The result of such an addition operation is a kind of "weld seam" that, via overlapping layers, allows complex shapes to be made.

There are many **materials** that can be used in the process, from bronze to stainless and tool steel. Still off-limits, for now, are reactive materials, i.e., those that react by igniting in contact with air, such as aluminum and titanium, because they would require a completely inert working environment.

Lasertec's innovative ability to **deposit metal materials** on existing surfaces, perfectly following their contours, suggested to Matteo Perini the idea of experimenting with the possible use of **hybrid technology** in the **repair of damaged objects**.

Such an assumption is particularly interesting in the case of **high-value or even unique pieces** that cannot be replaced in their entirety.

This is true whether they be ancient artefacts or mechanical components of a complex assembly line that need to be completely replaced even for very small defects.

These include, for example, **ship propellers** or **die-casting moulds**. In fact, in both cases we are talking about expensive elements, where even minor damage significantly compromises the functionality of the entire structure.

To date, the repair of these objects is carried out by material addition through welding, followed by time-consuming manual finishing. A process that, in fact, depends crucially on the experience of the worker and is therefore easily prone to error and very expensive.

In contrast, hybrid technology ensures full process repeatability and allows the added material to be reworked by milling, without ever having to change machines.

To this end, Perini **wrote software** that allows a **3D scan of the damaged object to be compared with its CAD solid model**, identifying surface defects. The three-dimensional models of the volumes to be restored are processed and passed on to the CAM, which creates tool paths to add material where needed and to finish, by milling, the surfaces to return them to their original state.

Thus, thanks to this program, the entire **repair process** can be **simplified** and made more efficient by avoiding errors both when adding material and when restoring the original form.

Experimentation is yielding excellent results, and new materials and even greater automation of the process will be implemented in the near future.

The value system of Polo Meccatronica

About **800 companies with 9,700 employees** operate in the mechanical-mechatronics supply chain in Trentino. A value cluster that sees the qualified presence of companies from the automotive, intelligent systems and robotics, sensor and industrial automation sectors.

This is the backdrop for the **Polo Meccatronica** project: a thematic hub covering a total area of 14 hectares, with modular manufacturing space available for new settlements and the **ProM Facility** laboratory for prototyping and product development.

The hub is based on the knowledge triangle of bringing together entrepreneurs, researchers and students.

In fact, about **50 companies**, ranging from large industrial groups to SMEs and innovative startups, operate here, but there are also research institutions such as Bruno Kessler Foundation, the University of Trento and three educational institutions (CFP Veronesi, ITT Marconi, Liceo STEAM International) with a view to creating synergy and specialized training.