Hyproline - EU Additive Manufacturing Initiative Case Study

CADfix supports innovative AM process for mass production of 3D printed parts

Business Drivers

- Time-to-market reduction
- Customized and innovative products with higher market value
- More accurate production and waste reduction
- Decrease in the number of rejects

Program Partners

TNO (Netherlands)

Swerea | IVF (Sweden)

Höganäs Digital Metal (Sweden)

CCM (Netherlands)

University of Birmingham

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Validating a flexible, high-performance manufacturing line

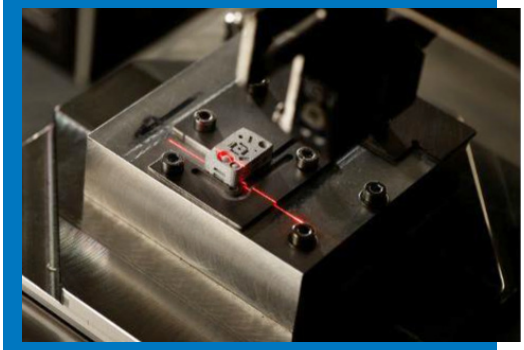
The consortium began as a result of an EU FP7 Factories of the Future Program grant. The goal of the Hyproline initiative is to design, implement, and validate a flexible, high-performance additive manufacturing line for serial fabrication of customized high-quality metal parts. The initiative combines innovative component technologies for net shape manufacture, direct write structuring, inspection, and intelligent automation.

Hyproline endeavored to develop production lines designed to produce multiple, unique parts, while simultaneously adapting to the specific requirements of a given component on the same line. The solution featured an innovative combination of additive manufacturing and laser-based structuring, coupled with integrated process monitoring and metrology systems. The results were successful.

Program researchers focused on three metals: stainless steel 316L, titanium, and copper, and on the serial production of customized parts in the order of 10mm with a goal of 10,000 parts/day.

One of the biggest challenges researchers faced was how to increase the quality of 3D printed metallic parts. ITI's CADfix greatly contributed to the solution through improved slice generation from CAD and the processing of inline 3D scanning and laser ablation with real-time point cloud capture and 3D comparison. This culminated in the generation of customized laser tool-paths for live use by the continuously running production line.

Hyproline: High-performance production line for small series metal parts



Industrial design is a major competition parameter for European small and midsize companies (SMEs) in the global market for detailed metal parts. Companies that specialize in complex, precision, high-performance, small series metal parts such as those in the jewelry industry, manufacturers of dental or medical implants, and those that are electronics-based are uniquely challenged. Cost savings for these manufacturers are typically realized as a result of repetition and volume.

However, as personalization trends increase across a variety of industries, a manufacturing protocol such as Hyproline gives manufacturers more opportunity for success.

photos courtesy of CCM

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Components of Hyproline

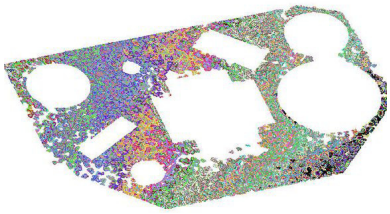
Hybrid platform – 100 separate parts in operation, 100 building/ machining platforms

AM components – products manufactured at 20um resolution, printed in steel, copper, titanium

Laser machining – both ablation and polishing performed

Software – comparisons among point clouds and nominal geometry, curved facet slicing for higher accuracy printing, software for inspection and analysis of products

Measurement – on-the-fly 3D measurement at reduced speed, using Micro-Epsilon Scancontrol laser line scanner



Rest volume created by CADfix within Hyproline that is ready to laser polish in the Phase III machine.

"The concept was initially focused on SMEs in the electronics and aerospace industries, but has potential application in other industries that produce low-volume, high-precision metal parts. We are excited about further developing this manufacturing platform to enable fully integrated mass production of customized 3D printed products."

-Frits Feenstra
Program Manager, TNO

CADfix contribution

Software development is an important component of Hyproline, given the very large data sets. The team made progress on data flow for scanning of geometries with very high precision and on the processing of that information.

CADfix, ITI's translation, repair, and defeaturing solution, was used to prepare CAD geometry for the additive manufacturing step, to convert the point cloud to the 3D surface, and to compare the as-produced 3D object with the CAD model while on the production line. CADfix was also used to generate tool paths to drive the laser ablation stage of the production line.

CADfix is ideally suited for this type of additive manufacturing because of its flexible, closely linked representations of geometry, ranging from continuous CAD geometry to discrete faceted geometry such as facets, slices, or point clouds. Access to multiple forms of geometry enables CADfix to be effectively applied to all aspects of the AM geometry process chain. For the Hyproline platform, CADfix compared the point cloud scans to the as-designed CAD to extract the excess material to be removed by the laser processing stage.

Outcomes

By further developing the manufacturing process itself, as well as researching and applying work on materials, treating the parts produced, and supporting software, Hyproline adds capabilities to commercially available manufacturing systems. These capabilities include speed, product quality, and versatility, thus improving time-to-market (TTM), which is a crucial competition parameter for SMEs. Hyproline promises to enhance the competitive position of Europe's SMEs.

The partners are confident that the Hyproline project will remove major technical barriers, which today inhibit the use of AM due to limited accuracy and the high product cost associated with the post-processing steps.

"This endeavor was truly ground-breaking because of the high speed of laser polishing of the metal parts, combined with 3D scanning to produce multiple, unique parts in the same run, on the same production line."
- Mark Gammon, ITI

Benefits

There are many benefits of producing metallic parts using Hyproline:

- Significant time savings
- The production of innovative detailed metal products that are impossible to copy with existing manufacturing techniques
- Reduction and combating of counterfeiting
- Miniature and lightweight detailed metal components provided at lower cost
- Better quality, higher availability, and adaptability of products
- More freedom of design

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