

Simulation of additive manufacturing processes for the production of metal components

Fortissimo Experiment Facts:

- Industry Sector: **Manufacturing**
- Country: **Italy**
- Software Used: **ABAQUS**



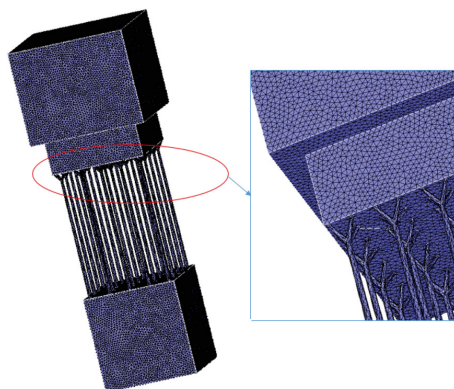
Topological optimization process (proof of concept)



Additive manufacturing Process Simulation (residual stress -proof of concept)



AM Process availability through collaborative environment (SaaS)



Specimen analysis domain (Thermal e Structural Mesh)

ORGANISATIONS INVOLVED

The Italian company HPE is an innovative provider of engineering solutions and technology to the world's automotive, motorsport, automation solution and defence sectors. Their major focus is on powertrain technologies.

EXEMPLAR is a company founded by the Politecnico di Torino University, which provides services for Computer Aided Engineering projects. Its focus is on the world of virtual prototyping and covers Engineering Services, Methodology development, Process Automation and Software Development. EXEMPLAR provides application expertise in this experiment.

The HPC expertise and resources were provided by the Italian HPC centre CINECA.

THE CHALLENGE

Additive Manufacturing (AM, also called 3D printing) technologies are generating huge interest in all industry sectors, as they enable the rapid design and manufacture of prototypes and products. However, there are challenges associated with using these technologies, such as component failure due to issues with layer deposition. There are multiple points during the fabrication process when the component being manufactured may fail due to this. Post-production failures of apparently complete parts can also occur.

THE SOLUTION

This experiment provided a numerical analysis environment which enables users to forecast the results of the AM process using cloud-based HPC simulation.

The forecasting tool is able to predict the stress state of the final component, as well as how the product deforms due to differential cooling during the manufacturing process. The multi-scale and multi-physics nature of the problem has been captured in the tool, allowing engineers to better understand this complex manufacturing process. This approach has created a robust solution by identifying which parameters most impact the quality of the final result before production begins, and which, therefore, need to be tightly controlled.

BUSINESS IMPACT

The impact this experiment for HPE has been to increase the effectiveness of its optimized AM solutions. The major benefits are a reduced time-to-market and a reduced number of defective parts, thanks to a closer match between the initial design and the manufactured part. This has consequently lowered costs.

Fortissimo Experiment Partners:

- High Performance Engineering srl (HPE) (End User)
- CINECA (HPC Expert & Centre)
- EXEMPLAR srl & University of Modena and Reggio Emilia (UNIMORE) (Domain Expert)

More Information:

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As regards the reduction in time required for tuning the AM process, there were two main outcomes. Thanks to this experiment, build failures and multiple design loops can now be avoided. The same benefits for HPE could be applied to any SME that purchases the service via the Fortissimo Marketplace. The results of the experiment are expected to increase HPE's market share by 50% and reduce costs (thanks to the lower levels of material wastage) by €90,000 per year.

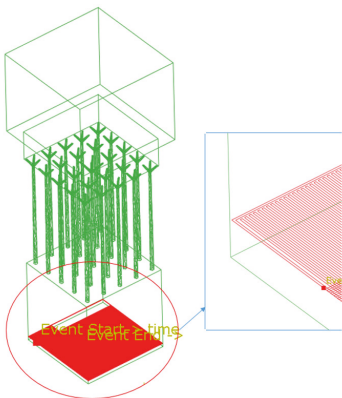
EXEMPLAR is able to offer the technology developed here as a commercial service under an SaaS model, with a potential annual turnover of €125,000.

BENEFITS

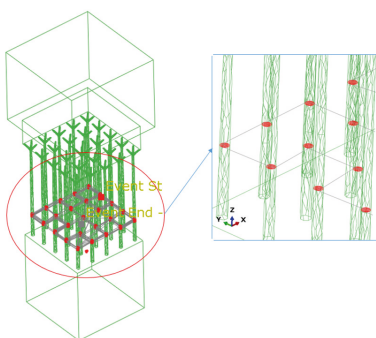
- HPE can reduce time-to-market of their products
- The number of defective parts can be reduced
- Consequent reduction in costs of up to €90,000 per year
- EXEMPLAR expects an annual turnover of €125,000 from SaaS offer

THE FORTISSIMO PROJECT

Fortissimo is a collaborative project that enables European SMEs to be more competitive globally through the use of simulation services running on a High Performance Computing cloud infrastructure. The project is coordinated by the University of Edinburgh and involves more than 100 partners including Manufacturing Companies, Application Developers, Domain Experts, IT Solution Providers and HPC Cloud Service Providers from 14 countries. These partners are engaged in over 90 experiments (case studies) where business relevant simulations of industrial processes are implemented and evaluated. The project is funded by the European Commission within the 7th Framework Programme and Horizon 2020 and is part of the I4MS Initiative.



Laser path used for AM process simulation in specimen base



Laser path used for AM process simulation in specimen supports

I4MS Fortissimo is part of I4MS ICT Innovation for Manufacturing SMEs: www.i4ms.eu



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