dilapro

DIGITAL LASER PRODUCTION

Project n° 101138859

DIGITAL TWINS OF LASER PROCESSING FOR MULTI-CAPABILITY MANUFACTURING OF COMPLEX COMPONENTS AND DIGITAL CERTIFICATION

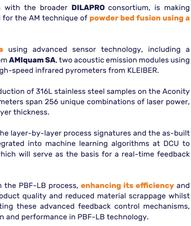
Newsletter #4

01. Robust numerical models of laser material interaction

Technical University of Denmark (DTU) is leading the consortium's activities within establishing robust numerical models of laser material interaction, that will constitute the core decision making toolset within **DILAFACT** software solution.

The team has scoped **multiple commercial and open-source modelling tools** (both those developed in-house and those available to use under different licensing agreements), and established workflows for predicting the various phenomena occurring during the laser-based production as well as their consequences (in terms of material properties, potential defects and expected component behaviour).

The methodology for combining these tools into digital twins capable of predicting and controlling the process has been recently presented at the **44th Riso International Symposium on Materials Science**.



44th Riso International Symposium on Materials Science
September 2nd to 6th 2024

The modelling tools are being combined into a unified workflow, with development of APIs planned for linking the outputs of one modelling tool with the inputs of the subsequent/parallel tool.

The computational accuracy vs computation time trade-off is significant to the deployability of the modelling tools, and the task is documenting and implementing the necessary model order reductions to achieve **DILAPRO**'s targets.

Simultaneously, the compatibility of the cloud computing platform (planned for running the models) with the modelling tools is being investigated and bespoke solutions are being developed.

02. Real-time feedback control system development

Dublin City University (DCU), in collaboration with the broader **DILAPRO** consortium, is making significant advances in real-time process control for the AM technique of **powder bed fusion using a laser beam (PBF-LB)**.

The team has begun **collecting in-situ data** using advanced sensor technology, including a dual-channel eddy current monitoring module from **AMIquam SA**, two acoustic emission modules using Avisoft CM16 ultrasonic microphones, and two high-speed infrared pyrometers from KLEIBER.

These sensors are being used to monitor the production of 316L stainless steel samples on the Aconity MINI PBF-LB machine. The PBF-LB process parameters span 256 unique combinations of laser power, scan speed, hatch spacing, laser spot size, and layer thickness.

The resulting **hyperspectral dataset** captures the layer-by-layer process signatures and the as-built material characteristics. This data is being integrated into machine learning algorithms at DCU to enable **highly accurate quality predictions**, which will serve as the basis for a real-time feedback control system.

This development has the potential to transform the PBF-LB process, **enhancing its efficiency** and enabling manufacturers to achieve improved product quality and reduced material scrappage whilst **optimising material properties**. By implementing these advanced feedback control mechanisms, DILAPRO aims to push the boundaries of precision and performance in PBF-LB technology.



03. Environmental Impacts of Laser Manufacturing Technologies

As discussed in newsletter #1, **DILAPRO aims to reduce the environmental impact of laser technologies.**

General guidelines and process mapping were just the first step! Now, we are evaluating the impact of laser technologies based on process maps.

To kick this off, we hosted a workshop discussing LCA in general and preparing for the probably most important and time-consuming step of an LCA: the Life Cycle Inventory (LCI).

To perform a good LCA and get a reliable result various definitions need to be made. For example, system boundaries need to be clearly defined, to decide what should be included and what is excluded from the assessment.
Functional units, describing exactly what function the product system will deliver, need to be defined.

After we finished defining these parameters, we went back to our process maps and based on those, we started to define an LCI. In this first step, we tried to systematically find all inputs and outputs of the processes identified in the process maps, for each of the use cases we are going to analyze.

To get a good overview, we used a generic template created in another EU financed research project and customized it for our use cases.

You can find the generic template here:
10.5281/zenodo.6577227

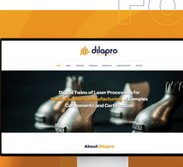
We are now going to use the templates to collect as much data as possible, while we are manufacturing our use cases. For example, we plan to evaluate energy usage, material usage and gas usage during manufacturing. The analyzed use cases will represent all laser manufacturing technologies involved in **DILAPRO**.

To evaluate the different impacts, we are for example going to install plug meters on our machines for energy usage, weigh the powder before and after the build job, and calculate the gas usage based on printing time and the technical documentation.

Later, we will use this data to calculate the environmental impact of the use cases and find energy consuming hot spots in production.
Based on the hot spots and a literature review, this WP will give recommendations to the rest of the project on where to focus their research on optimizing laser production strategies, to minimize the environmental impact. On of these factors could for example be the layer height.

We will also link the environmental impact to costs by finding prices for the consumables and materials of each of the use cases. This will help us to find the right parameters to focus on from an environmental and economic point of view.

Events



DILAPRO Showcased at INOV.AM Conference in Braga!

On November 27th, EWF had the honour of presenting "Digital-Enabled Certification and Qualification in Additive Manufacturing – The DILAPRO Approach" at the prestigious INOV.AM - Innovation in Additive Manufacturing Conference in Braga, Portugal.

Read More



DILAPRO's Impact at Formnext 2024!

The DILAPRO Project made waves at Formnext 2024, the world's premier trade fair for additive manufacturing (AM) and industrial 3D printing!

Read More



DILAPRO at EXPOMETAL 2024!

The DILAPRO Project was proud to be part of EXPOMETAL 2024, held from November 7–9 at ExpoSalão, SA in Batalha, Portugal.

Read More

Follow US



DILAPRO Website

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.