Driving innovation in additive manufacturing: Enhancing efficiency and certification

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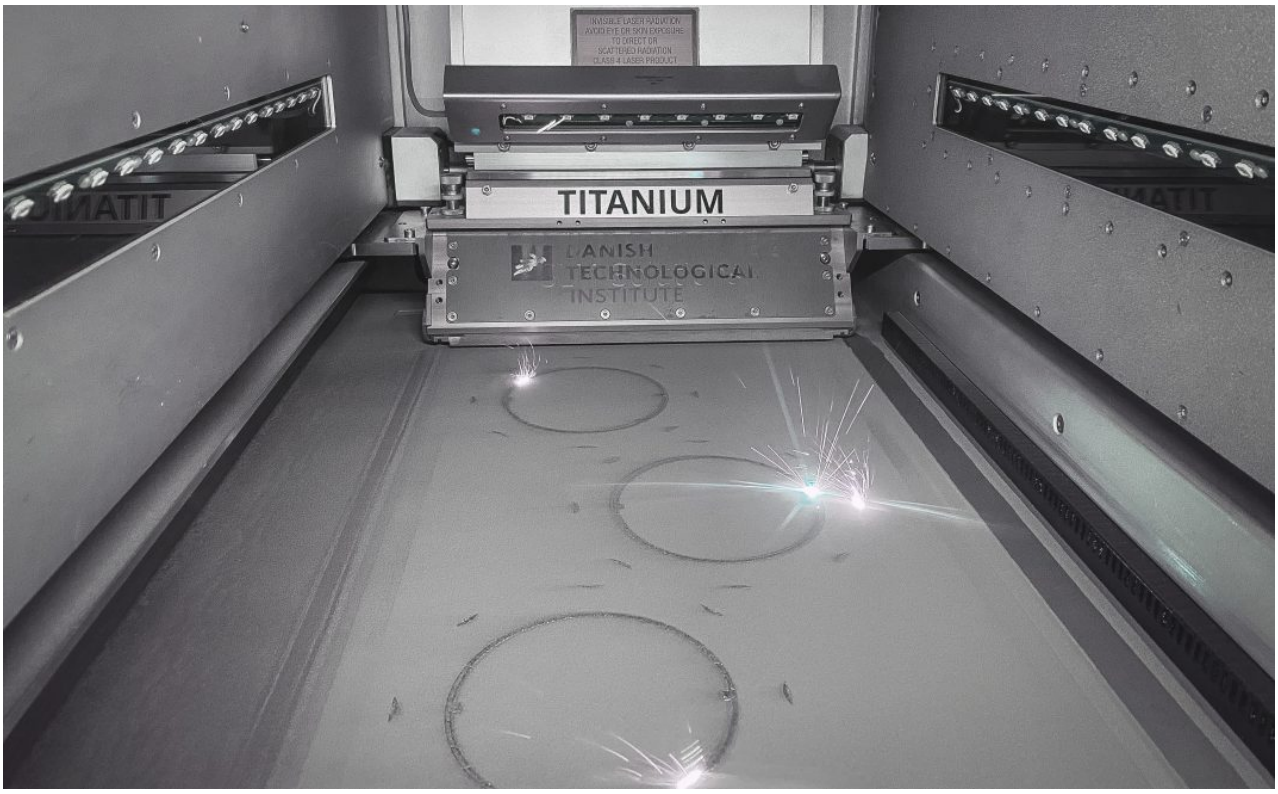

Image: Danish Technological Institute

Ana Queirós Barbosa[(1)] and Christina Moeslund Zeuthen[(2)], explore driving innovation in additive manufacturing, explaining precisely how DILAPRO enhances efficiency and certification

The rapid advancement of industrial automation and breakthroughs in fibre laser technology are not only transforming sectors like manufacturing, aerospace, automotive, and electronics but are also accelerating the adoption of additive manufacturing (AM) as a key production method. AM is revolutionising industrial production, enabling the creation of high-performance components with intricate geometries. However, the widespread adoption of laser-based AM is hindered by challenges in quality assurance, regulatory compliance, and certification processes – critical concerns in industries where precision and reliability are non-negotiable.

DILAPRO introduces a digitalised, integrated framework to address these challenges and enhance production efficiency and certification workflows. Central to this innovation are two cutting-edge software tools:

- DILAFACT (Digital Laser Factory):
  A platform that leverages digital twin technology to optimise production planning, real-time quality monitoring, and process control, reducing waste and improving efficiency.
- DILACERT (Digital Laser Certification):
  A solution that streamlines certification procedures, ensuring compliance with ISO/ASTM and the International Additive Manufacturing Qualification System (IAMQS).

By embedding these tools into the AM ecosystem, DILAPRO enhances manufacturing consistency, reliability, and sustainability, thus accelerating the adoption of laser-based AM across highly regulated sectors.

Beyond technological advancements, tight collaboration with end users in the industry is required to create real value. This is achieved through the DILAPRO Laser community, which features workshops and newsletters to create a dynamic hub for innovation, collaboration and advancement in laser-based manufacturing technologies.

DILAFACT: Digital laser manufacturing for precision and sustainability

The DILAFACT platform represents a groundbreaking step in digital laser manufacturing, offering a comprehensive simulation environment that can model laser-material interactions at both material and microstructural levels. By integrating precise modelling of additive, subtractive, and thermal processes, DILAFACT allows manufacturers to make informed, data-driven decisions. This enables the optimisation of key parameters such as material properties, laser power, and environmental conditions, significantly enhancing production efficiency.

A core advantage of DILAFACT is its contribution to sustainable manufacturing. By refining process parameters, the platform reduces raw material waste by up to 64% and lowers energy consumption by 27%. These improvements align with global sustainability goals while ensuring the quality and reliability of laser-based manufacturing.

DILACERT: Digitalising certification for laser-based additive manufacturing Ensuring compliance in AM is traditionally a resource-intensive and time-consuming process. DILACERT revolutionises this by introducing a semi-automated approach to certification. Using digital twins and real-time data monitoring, DILACERT automates key aspects of quality verification, significantly reducing manual documentation efforts while accelerating certification cycles. This lowers production costs and enhances manufacturers' ability to meet stringent industry standards more efficiently.

A key innovation of DILACERT is its alignment with the International Additive Manufacturing Qualification System (IAMQS), which offers a structured framework for certifying both AM parts and the personnel involved in their production. Integrating with DILAFACT enables DILACERT to utilise in-process monitoring data to validate part quality early in the production cycle. This proactive approach minimises the risk of defects, ensuring that only fully compliant components proceed to final certification.

Advancing industrial automation and laser processing through DILAPRO

As industries shift towards sustainable and efficient production, automation solutions are becoming essential for optimising manufacturing and distribution. DILAPRO addresses this demand by advancing multi-purpose laser processing and digitalisation strategies, ensuring that Europe remains competitive in the global market.

DILAPRO integrates three core laser technologies – Laser Powder Bed Fusion, Directed Energy Deposition, and Laser Texturing – to enable high-precision manufacturing, complex component production, and surface modification. This multi-processing approach enhances flexibility in customised production while reducing lead times by up to 50%.

By utilising Digital Twins and AI-driven process optimisation, DILAPRO minimises material waste, defects, and energy consumption, contributing to sustainability goals with up to 90% reduction in scrap rates through defect-free manufacturing, and enhanced predictive modelling for first-time-right production.

DILAPRO's contributions to standardisation and digital certification

DILAPRO is key in advancing additive manufacturing and laser processing standards, bridging the gap between physical and digital quality assurance. The project builds upon existing industry standards, using them as a foundation for demonstrator audits and the validation of inline monitoring controls.
Machine manufacturers will also be engaged, facilitating the incorporation of inline monitoring and digital certification directly into next-generation laser processing systems.

Through these efforts, DILAPRO aims to modernise certification processes, enhance quality control, and drive digital transformation in European manufacturing.

Conclusion

By incorporating advanced digital tools, the DILAPRO project facilitates real-time process monitoring and automated certification. This approach ensures compliance with international standards and promotes a more sustainable and efficient production environment.

This is critical in driving the evolution of AM toward a future characterised by digitally enabled, environmentally conscious production. As AM technology continues to progress, DILAPRO's work will play a pivotal role in shaping the certification and regulatory practices necessary to ensure the production of safe, reliable, and high-quality AM products across various industries.

Beyond DILAPRO, all project partners and the Danish Technological Institute – Project Coordinator and RTO with extensive AM competencies – are open for future projects or collaborations concerning novel AM tools within software, materials, or sustainability.

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