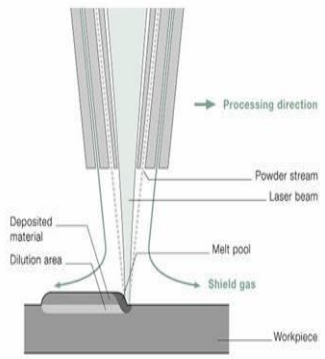
MERLIN - Reducing the environmental impact of air transport using additive manufacturing techniques in the manufacture of civil aero engines

The MERLIN project aims to reduce the environmental impact of air transport by using additive manufacturing (AM) techniques in the manufacture of civil aero engines. MERLIN will seek to produce higher performance additive manufactured parts in a more productive, consistent, measurable, environmentally friendly and cost-effective way.

Project objective

Laser energy can be used to (re)melt small amounts of material in a precise manner using a minimal heat input. Through advances in computer technology, a first laser-additive, rapid manufacturing process emerged whereby parts were produced layer-by-layer by polymerising a plastic monomer. A metallic powder-variant of this concept was developed, with its simplest form, laser cladding, applied in a single layer to enhance the properties of a material surface. Although extensively used for prototyping, the direct application of this concept in manufacturing is growing.



The laser powder bed concept operates by scanning a focused laser beam across a bed of powder, locally fusing the powder in a pre-determined pattern. Upon completion of the first scan a new layer of powder is applied on top of it and the process is repeated, building up the part layer-by-layer. Laser Metal Deposition (LMD) operates by locally melting a substrate, or underlying layer, and introduces additional material into the melt pool.

There are two LMD processes considered in the MERLIN project:

1) LMD-p makes use of metal powder to clad conformal surfaces and to build up self-supporting 3D structures. The powder, delivered through a nozzle into a molten pool created on a substrate by a transient laser beam, is used to form the material layer. Building up a series of layers, each one being fusion bonded to the underlying layer, allows surface features and 3D geometry to be realised.

2) LMD-w operates in a similar way to LMD-p but instead of blowing powder into the melt volume, LMD-w introduces wire from a continuous spool feeder.

Laser-based additive techniques will be at the core of the development in MERLIN because of the nature of the materials to be processed and the parts required by aero engines. Laser techniques provide both low heat input, accurate and small feature creation, and good surface finish which cannot be delivered by electron beam and arc-based additive techniques.

Currently the OEMs involved in civil aerospace jet engines have come to tolerate low material usage ratios, which would not be considered viable in other industry sectors. Given the environmental pressures that will increasingly be placed on the industry, this approach is not sustainable in the long term.

It is forecast that over the next 20 years 24,300 new passenger and freight aircraft will be delivered to support worldwide demand. This will result in a requirement for approximately 60,750 engine deliveries with an estimated total wastage of approximately 1.28m tonnes of high performance material.

For further information, please visit the project website at **www.merlin-project.eu**.

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