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ALM: Industrial strength 3D printing

ALM is the industrial-strength version of 3D printing, says Paul Sillers

Rolls-Royce has 3D-printed the largest aero engine component in the world

Everybody knows Auguste Rodin's iconic sculpture The Thinker, but what was the artist thinking about whilst chiselling away at his block of plaster? Probably the same thing that designers of jet engine fan blades think about when they're planning the manufacturing process: how to remove the exact amount of superfluous material — and in all the right places — to reveal a masterpiece. This subtractive process, envisioning the end result submerged within a solid block, then craftily trimming off the unwanted bits, has been the

traditional approach to manufacturing many of the intricately shaped components we find in airliners.

Of course, in aviation, less is more. Designers strive for less weight, less wastage, less steps between raw material and finished product, which is why the trending phenomenon of Additive Layer Manufacturing (ALM) — the industrial-strength version of 3D printing — is becoming a more conspicuous blip on the aerospace manufacturing radar.

ALM is the inverse of conventional manufacturing. Instead of shaving off material, the process starts with nothing, then incrementally adds slender layers of powdered metal (or other substance), fused together using a high-energy source, usually laser. All the magic takes place within a box-like machine, about three metres wide.

ALM allows "more efficient use of materials, which reduces both the effects of mining and recycling of machining waste," explains Iain Todd, Professor of Metallurgy and Materials Processing at the University of Sheffield. "Through clever changes in component design, we can reduce the weight of structural components."

Professor Todd directs the University's Mercury Centre, which focuses on radically improving resource efficiency and accelerating production timescales. He and his team are collaborating with Rolls-Royce on one of the aerospace sector's most ambitious ALM programmes to date: design and manufacture of a 1.5m diameter Front Bearing Housing (FBH), a structurally critical part of the Trent XWB-97 engine - the next generation of airliner powerplants.

"ALM offers great potential, and we want to explore and maximise its use as much as possible," says Rolls-Royce's Kathryn Bell, director of communications at its Aerospace Division. Such is the company's confidence in ALM's future that Rolls-Royce reasons, "It opens up our design potential and allows us to be especially innovative both in the design and manufacturing of our product, and it is in these areas — along with lead-time reduction — that we are especially focused."

The Trent's FBH is manufactured in titanium, an established staple of the aero-industry diet. But over the next decade, concoctions of hybrid materials will extend the scope of what ALM can deliver.

The genius of ALM as a system is that once designed, a component can be 'printed' wherever there's an ALM machine, circumventing the need for storage and transportation. Therefore, urgently required parts can be manufactured remotely on demand. What would Rodin and his meditating muse think about that?

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