A Fraunhofer ILT staff member demonstrates how blisks are generated using laser material deposition

READY FOR TAKE-OFF WITH AdaM

Nikolaus Fecht reports on the 2nd International Conference on Turbomachinery Manufacturing (ICTM) in Aachen, where the industry and the research community officially launched a new innovation cluster called AdaM.

The innovation cluster for Adaptive Production for Resource Efficiency in Energy and Mobility (AdaM) unites 21 industry partners in trying to harness new technologies and concepts to improve resource efficiency in the fields of energy supply and mobility. The area of North Rhine-Westphalia (NRW) is one of the project's sponsors.

"We should also spend the next few years finding ways to make the best use of existing approaches," begins Johannes Remmel, NRW's minister for climate protection, environment, agriculture, nature conservation and consumer protection. He emphasised NRW's financial and moral commitment to the AdaM project, which sends a message that the regional government intends to tackle the energy transition with more than just electric vehicles and increased use of wind and solar power.

It was not only the technology that impressed the minister, but also the network behind it. In considering adaptive and conventional techniques for manufacturing and repairing the turbines used in aircraft and power plants, the network focuses on those techniques that take a holistic approach and incorporate the entire production process. The key message is that two factors are driving process chains to become increasingly complex in future. First, the adoption and integration of more economically viable steps, and second, the use of specific combinations of materials to suit the local load spectrum at various points on components.

Begin at the beginning

Professor Dr Fritz Klocke, institute director of Fraunhofer IPT, encouraged the 250 ICTM participants in their endeavours to innovate.

"There are things that might not pay off today, but could well pay off in future," he explains. For Dr Klocke, AdaM is an important tool in starting out in new directions. The new cluster favours adaptive production for its flexibility in dealing with unforeseeable future requirements. The point, according to Dr Klocke, is "to be able to

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250 participants from around the world participated in the 2nd International Conference on Turbomachinery Manufacturing (ICTM) in Aachen

react to sudden events". The Fraunhofer Institutes for Production Technology IPT and for Laser Technology ILT, aren't simply conducting scientific research in an ivory tower – their work centres on actual projects, and has direct practical application for new turbomachinery concepts and components.

Among those involved in AdaM are prominent companies such as MTU Aero Engines. The engine manufacturer's primary concern is the MTU Technology Roadmap, with its Clean Air Engine (Claire) project, which aims to lower engines' fuel consumption by more than 35% from the levels achievable with current technology by 2035. The first step, in the form of the geared turbofan, is to be completed by 2015. Geared turbofans use 15% less fuel and generate just over half as much noise as their predecessors. Their repair and maintenance costs are also 20% lower than previous models. This new engine has already been chosen by five important clients for their new aircraft, including the Airbus A320neo. Blisks are of central importance to this pioneering engine design. MTU is in the process of building a new manufacturing facility that will produce 3,000 to 4,000 blisks per year, and the production method that will be used was developed in Aachen.

"The energy density of these new engines is much greater, as the engines are getting smaller," states Dr Erich Steinhardt, MTU's senior vice-president of technology. "But this does require larger components." On account of this, components that must withstand particularly high temperature and pressure stresses, such as airfoils and their casings, now tend to be made of carbon fibre reinforced plastics (CFRP)

rather than metals. MTU's engines are not intended for use in this field, however. Designed to have a diameter of about 1.3m, they are more suitable for smaller aircraft.

"Blisk technology is already prevailing in this area," notes Dr Steinhardt, "but here the technology is required not only for manufacturing but also for maintenance." This is where super polishing comes in, as a way to improve the surface quality of the blisks in order to achieve a small increase in their efficiency. Alternatively, their structure could be improved using bionics, in this case borrowing ideas from shark fin design. As things stand, however, Dr Steinhardt is still sceptical about the potential offered by shark fin structures.

"The future calls for blisks that are welded to form drums," Dr Steinhardt explains. "We've already succeeded in producing a tandem blisk drum." This involves very precise, high-grade manufacturing processes in which inertia welding is applied to components made of titanium or thermally stable nickel alloys to form highly accurate drums that display an eccentricity of less than 0.2mm and an axial tolerance of under ±0.25mm.

An eye on the future

In looking to the future, Dr Steinhardt points to additive manufacturing (AM), seeing it as a technology that could potentially be used both in blisk repair and for series manufacture of an estimated 30% of the components that go into an engine. MTU has

Dr Fritz Klocke, director of Fraunhofer IPT, Aachen

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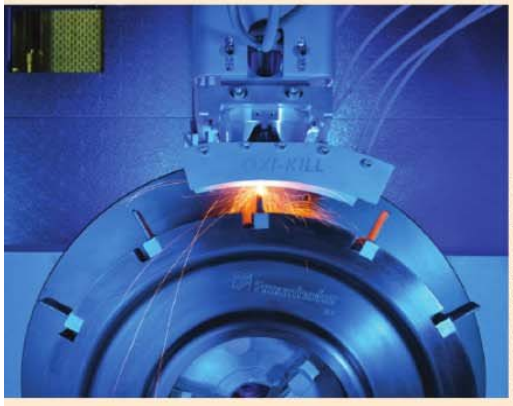

Fraunhofer ILT, Volker Lannert

Inertia welding forms accurate drums

already begun using AM to produce test components and prototype engines. "We are stepping out into uncharted territory by approving AM components such as these," says Dr Steinhardt. "One important challenge is maintaining process stability, in order to ensure that the quality of materials and surfaces remains constant."

Dr Hamid Mughal is executive vice-president manufacturing at Rolls-Royce in Derby (UK), which is involved in AdaM through its German subsidiary, and as a proven production specialist he was able to give an insight into competitive manufacturing strategies within the aerospace industry.

"85% of aerospace industry manufacturing processes and techniques are not standardised," he says, explaining that 400 different standards are needed just to produce a single turbine disk. "We believe that the solution lies in running extremely costly, innovative processes within a manufacturing environment in order to work up standards as we go along."

Rolls-Royce is collaborating in this way with 66 industrial companies at the University of Sheffield's Advanced Manufacturing Research Centre (AMRC), where production specialists and researchers can work together to try out new ideas free of normal production constraints. And it works: to date, 150 programmes have been executed in all research centres of this kind, "that has improved our methods by 30 to 60%," according to Dr Mughal. "The potential this offers for implementing your own standards is vast! But ensure you're working on the processes, and not on the products." |

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