CUSTOMER STORY

A HEAD START WITH 3D PRINTING

ALTAIR SOLUTIONS REDUCE WEIGHT OF A 3D-PRINTED MILLING HEAD

About the Customer

Regional Technological Institute (RTI) is an independent institute affiliated with the University of West Bohemia, located in Pilsen, Czech Republic. Renowned as a top-level scientific research centre, RTI specializes in advancing engineering solutions and helps organizations around the world boost their competitiveness. Focusing on metal machining and metal additive manufacturing, the center collaborated with Advanced Engineering s.r.o. – an Altair channel partner – on a trailblazing research project that aimed to design a lighter, more dynamic, more efficient manufacturing milling head.

"Lightening the milling head with topology optimization improved its dynamic properties, enabling it to speed up the milling process and reduce its energy consumption.

Miroslav Zetek, Head of Department of Machining Technology, Regional Technological Institute, University of West Bohemia

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Their Challenge

Because milling machine designs must meet stringent performance and robustness requirements, they're traditionally crafted from solid materials. High-performance mechanical transmission components like milling heads are some of milling machines' most intricate, most expensive elements. These components require extensive fluid transport piping to deliver coolant and must satisfy demanding mechanical performance standards. Furthermore, traditional manufacturing methods, such as drilling, impose significant limitations on the orientation of the internal channels.

Together, RTI and Advanced Engineering s.r.o. sought to design an innovative steel milling head. Their design goals were to enhance the milling head's reliability while reducing the weight of moving parts; maintain mechanical performance; increasing blade cooling efficiency to extend tool life and optimize tool change intervals; lower energy consumption; and enable refurbishment after collisions. For manufacturing, RTI intended to use direct metal laser sintering (DMLS), a state-of-the-art additive manufacturing (AM) technique for 3D printing metal components. In simpler terms, RTI would be using DMLS to print steel components.

Our Solution

RTI benefited from access to the entire **Altair® HyperWorks®** design and simulation platform to develop and validate their new milling head.

The project included the following steps:

Material validation: To start, the team validated the printed steel's material properties, considering it both as a solid material and in lattice structures. Samples printed at varying angles were tested using quasi-static and dynamic methods. **Altair® HyperStudy®** was used for validation.

Topology optimization: Next, the team performed topological optimizations using **Altair® OptiStruct®**. The team explored classical topology, lattice optimizations, and size optimizations. This process ensured the designs met performance and weight reduction requirements.

Impact testing: From there, the optimized designs underwent virtual impact testing in **Altair® Radioss®** to ensure durability and performance under operational conditions.

Post-processing: Lastly, for post-processing, the team used **Altair® HyperView®** and **Altair® HyperGraph®** to evaluate the results, ensuring the final design met their goals.

This comprehensive approach enabled the team to create a highly optimized milling head design suitable for DMLS production.

Results

RTI's milling head underscores how transformative advanced simulation and AM technologies can be in driving engineering innovation. Simply put, it would have been impossible to optimize the milling head in this case study without using AM. The result was a lightweight, 3D-printed milling head with unique features that can only be created using AM. Compared to bulky, fully solid milling heads created using traditional methods, RTI's design is lighter and has significantly better dynamic properties while still meeting stiffness requirements.

Additional key outcomes included:

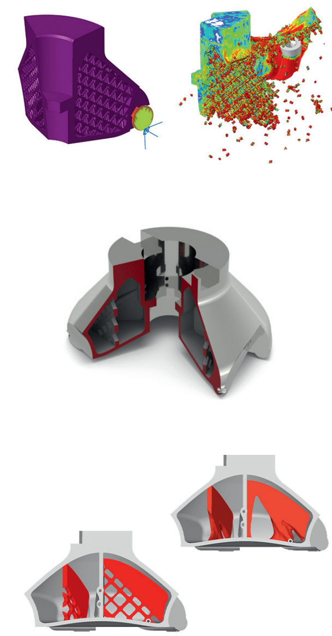
Weight reduction: The use of topologically optimized structures helped RTI reduce the milling head's weight by 64% compared to traditionally manufactured designs.

Improved dynamic properties: Lighter components improved the milling head's dynamic behavior, helping it speed the milling process.

Enhanced cooling: Internal lattice structures and optimized coolant channels improved blade cooling and extended tool life.

Energy efficiency and durability: The new milling head required less energy during operation and gave users ability to refurbish the milling head after collisions.

Thanks to Altair technology and AM, RTI has patented the new optimized design, giving manufacturers the chance to license and utilize it in their operations. Overall, this will help reduce energy consumption and make milling processes around the world quicker, more efficient, and more sustainable.



TOP: Crash analysis of lattice structure **MIDDLE:** Render of optimized design **BOTTOM:** Variants of topology and parametrical optimization

ADVANCED ENGINEERING s.r.o.

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