

nTopology



Cobra Aero Reimagines the Air-Cooled Combustion Engine Cylinder using Field Driven Design

Instead of fins, Cobra Aero opted for a lattice structure as the heat transfer medium for their UAV engine cylinder. To optimize its performance they combined results from multiphysics simulations to spatially vary the thickness and density of the lattice.

The result: an engine cylinder that is more efficient, meets weight requirements, needs minimal support during manufacturing, and performs exactly as the simulation models predicted.

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“By the time we were done, our models had evolved to the point where they were simply beautiful! Apart from the lattice, [...] we were able to integrate the cooling duct with the cylinder itself, consolidating parts into a single piece.”

Sean Hilbert, President of Cobra Aero

Cylinder weight

420 grams

Maximum Temperature

50% less wasted material

Part Consolidation

From 6 parts to 1 component

Experimental validation

Performance according to specs

Manufacturing process

Renishaw AM500

Material

AlSi10MG

Background

To stay competitive, Cobra Aero, a US-based manufacturer of UAV drone engines, invested in a Direct Metal Laser Sintering (DMLS) system.

The team knew that redesigning key parts of their engine for Additive Manufacturing would yield many advantages — but, at the beginning of their journey, they didn't realize how much more we could achieve. nTopology's field-driven design and simulation capabilities played a key role in developing this new product following DfAM best practices.

Business Value

Utilize manufacturing equipment
Grasp the full benefits of Additive Manufacturing by designing for the processes.

Develop better products
Stay ahead of your competition by developing high-performing products that meet multiple requirements.

Adapt to market demands
Adopt flexible design processes to expand your offering and move fast when an opportunity arises.

Lattices as an Alternative to Fins

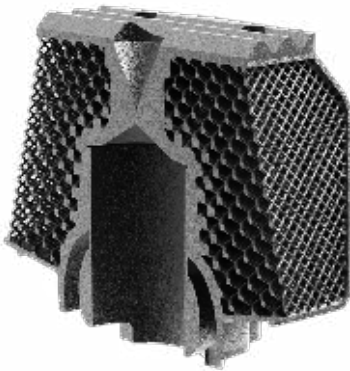
Looking for alternatives to fins, the engineers became intrigued by the lattice structures they saw being used for heat exchanger design. As a bonus, lattices are lightweight, compact and self-supporting.

Using nTopology's advanced modeling capabilities, Cobra Aero was able to quickly generate different sizes of lattices with varying strut thickness, filling-in the lattice inside their cylinder geometry and terminating it with smooth transitions and fillets between the struts.

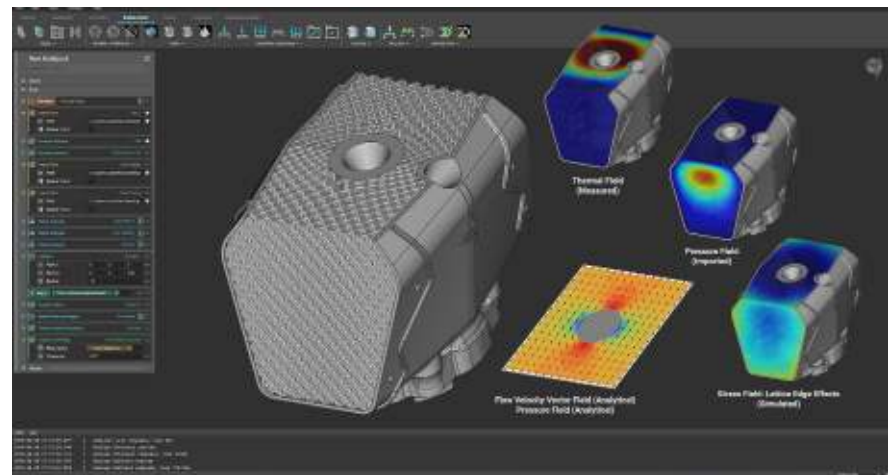
Optimizing the Lattice for Heat Transfer

Cobra Aero used nTopology's field-driven design capabilities to spatially control the properties of the lattice. They used a range of multiphysics simulation results as input — temperature, airflow velocity, pressure drop, and mechanical stresses — to generate a highly optimized structure.

Simply put, they tightened the lattice structure in areas where conduction was more important, while in areas where convection was more important and more airflow was needed to pull the heat away, they loosened the lattice structure.



Cross section of the combustion engine cylinder showing the internal variations of the lattice



Field-driven design enables you to use simulation results as design parameters to control your designs

Manufacturing & Testing

When the team finalized their design, they used nTopology's slicing capabilities to export a CLI file that was sent directly to the Renishaw AM500 system for manufacturing.

Testing showed that the new lattice structure design was more efficient than the fin design. In every loading case and at every RPM, less airflow was required to maintain proper engine temperature.

About nTopology

nTopology was founded in 2015 to enable engineers and designers to create any geometry, no matter how complex, and meet the engineering requirements of high-performance products. Our software is used from research through production to create breakthrough processes and products for the aerospace, automotive, medical, and consumer industries. Our customers depend on nTopology's generative design capabilities to take full advantage of new hardware, optimize parts where performance is critical, overcome design bottlenecks, and augment their traditional CAD, simulation, and engineering software stack.

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