Market Sector:
AEROSPACE

Technology Theme:
ELECTRIFICATION / ADDITIVE MANUFACTURING

FUTURE ELECTRIC MOTOR SYSTEMS 3 (FEMS3): AEROSPACE MOTOR

ADVANCING ELECTRIC MOTORS THROUGH ADDITIVE MANUFACTURING

The MTC designed and manufactured an electric motor casing using advanced design tools that compliment the additive manufacturing process. Implicit modelling and repeatable workflows allowed an iterative design approach, producing a high power dense motor with reduced assembly complexity.

> The success of decarbonization initiatives relies on the convergence of multiple advanced technologies. This work by the engineers of MTC is a fine example of how design tools with advanced modelling and design automation capabilities can be used during product design to quickly fine-tune and optimize complex designs and elevate the benefits of additive manufacturing.
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> **Alkaios Bournias Varotsis PhD, Product Marketing Manager, nTopology**

THE CHALLENGE

The drive to net zero has created a necessity for electric motors to target a wider range of applications. Where higher performance is required efficiency is key, and therefore the design and manufacture need to enable a high degree of optimisation.

Conventional manufacturing routes limit design freedom, falling short of a highly efficient motor design, therefore the exploration of disruptive manufacturing technologies such as Additive Manufacturing (AM) is required.

The limitations in design for conventional manufacturing processes also limit the ease of assembly, requiring multiple components and numerous fixings. Assembly of a high performance motor could be improved though AM.

MTC'S SOLUTION

Using a combination of Siemens NX and nTopology enabled an end to end workflow to support manufacturing whilst enabling high design complexity with reduced computing effort.

nTopology offered a solution for topology optimisation, implicit modelling and automated workflows which streamlined the approach to producing components that met the functional requirements of the application, whilst also utilising the full benefits of the AM process.

The AM process team developed optimised process parameters for a high strength AM aluminium alloy (A20X).

THE OUTCOME

The MTC team redesigned the subtractive manufactured casing and combined 3 machined components, 8 fasteners, and 3 O-rings into a single part. Developing optimised processing parameters for a high strength Al alloy (A20X) ensured the casing was strong enough to meet the structural requirements, was light weight and minimised material usage. The result led to a reduced mass of over 65% compared to the original CNC casing, and benefits including reduction of assembly steps, elimination of multiple seals, and reduced lifetime environmental impact.

The motor is designed for 74Kw (peak)/27Kw (cont.) with a total mass of 10.4kg providing an output of 7.1 kW/kg.

The motor design won its category at the 3D pioneers challenge, an international AM design competition, receiving praise for its leveraging the advantages of AM to improve performance and sustainability.

BENEFITS TO THE CLIENT

AM has been demonstrated as a viable manufacturing route for high performance electric motors where the increase manufacturing cost is offset by the improved performance and potential cost savings throughout its service life.

Advanced design tools offered through nTopology enabled greater design freedom to fully exploit AM. Demonstration of reusable workflows enables an iterative approach to design as well as being able to use across component families.

A more efficient assembly process can be achieved through the consolidation of components and removal of fasteners and seals. The use of one way and zero turnover assembly provides a more efficient, reduced step workflow assembly process.

> The aerospace motor showcases the potential of additive manufacturing and advanced design tools to progress the design of electric motors. Implicit modelling offered by nTopology was key in the design process, utilising repeatable workflows to rapidly develop the design from ideation to the validation, as well the range of lattice and architected material tools to improve the functionality of the design.
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> **Ollie Hartfield, Advanced Research Engineer, MTC**

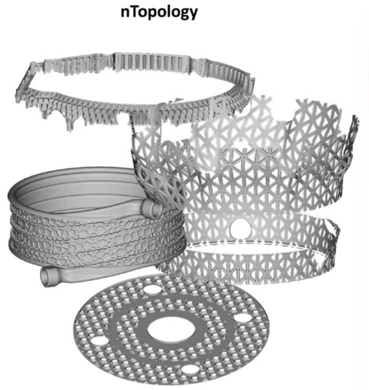
↓65%
Mass Reduction

14
Parts into one

7.1
kW/kg

NX

nTopology



Output

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