

A GAS TURBINE ENGINE EMISSIONS RAKE WITH MULTIPLE SENSORS WAS RE-ENGINEERED, BY CREATING COMPLEX INTERNAL CHANNELS, TO CONSOLIDATE SEVERAL COMPONENTS INTO A SINGLE PART AND TO EVALUATE THE AUTODESK NETFABB PROCESS SIMULATION TOOLS.



BACKGROUND

A rake is a probe or probe assembly with multiple tips that allows for multiple measurements of gas turbine engine performance to be taken simultaneously.

This results in a complex component design, which is expensive to manufacture, susceptible to mechanical damage, and difficult to repair. A lack of replacements on site sometimes keeps planes on the ground until a replacement is produced.

Additive Manufacturing (AM) has the potential to reduce manufacturing cost and provide replacements on-demand with reduced lead times.

MTC'S TECHNOLOGIES

- ▶ Design for additive manufacturing
- ▶ Physics modelling & process simulation
- ▶ Metal laser powder bed fusion

MTC'S SOLUTION

The rake was redesigned to take advantage of the benefits of AM. This included consolidation of several parts into a single component and improved part functionality. The internal structure was redesigned to be self supporting, reducing the post-processing time required.

AM build distortion was then predicted using simulation tools. These were compensated for before a demonstrator part was produced in Inconel 718. The built part was inspected against the nominal design to validate the simulation tools and the part design.

MTC'S SPECIALITIES

- ▶ Identification of the opportunities for AM application.
- ▶ Design optimisation to leverage the capabilities and minimise the risks of the manufacturing technology.
- ▶ Evaluation of emergent simulation tools and validation of the models.

THE OUTCOME

- ▶ Aerodynamic sensor housing with complex internal structure.
- ▶ Emissions rake design optimised to reduce the number of supports required.
- ▶ Increased confidence in the process simulation models to predict the distortion of components.

BENEFITS TO THE CLIENT

- ▶ Consolidation of what would be more than 12 parts into a single component, reducing the number of inspections needed.
- ▶ Reduction in assembly lead time.
- ▶ Validation of metal powder-bed risk minimisation tools.
- ▶ Greater understanding of the parameters of process simulation tools.

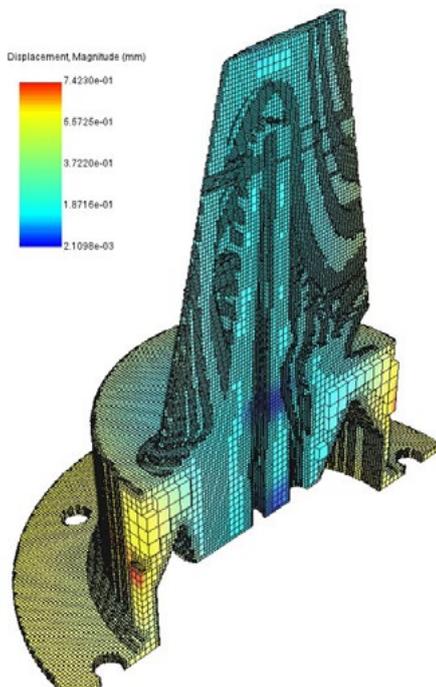


Additive manufacturing promises the possibility of massively reduced lead times. Through the use of simulation tools like Autodesk Netfabb, potential build failures can be identified and mitigated before any material is melted which is critical to achieving this goal.

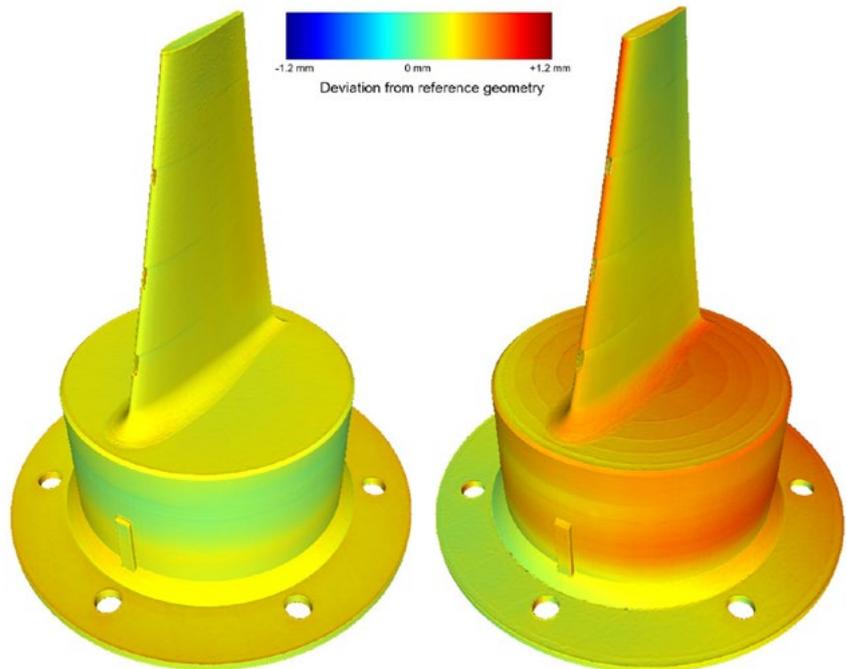
Adam Holloway, Senior Research Engineer, MTC



DISTORTION SIMULATION



NOMINAL & COMPENSATED GEOMETRY



MORE INFORMATION

Technical details regarding this case study including reports and files are available on the NCAM [Knowledge Hub](#).