

Demonstrator part: Thrust Nozzle

9 September 2014



End user

HiETA Technologies Ltd (www.hieta.biz) is a Design and Product Development company that exploits the opportunities available through the use of Additive Manufacture (AM) for complex and high performance products. The design freedom offered by AM realises geometries that are not achievable by other manufacturing processes. It allows HiETA to create highly efficient, light, and where necessary, multi-function products. All HiETA's products are designed to utilize the new freedoms in order to increase performance whilst reducing weight, space, thermal efficiency. The LIGHT project provides an opportunity to explore new designs and applications using multi-functional lattice structures. By participating in the project it will increase penetration in the targeted markets.

Objective of the demonstrator part

The objective is to optimize and to reduce the weight of the Thrust Nozzle whilst improving its heat transfer characteristics whilst maintaining its integrity.

Description of the demonstrator part

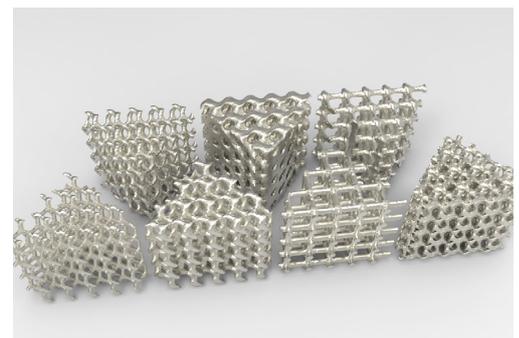
Within the LIGHT project HiETA have chosen to develop the application of lattice structure to rectangular Thrust Nozzles that are located on the exhaust of jet engines. The additive of the Nozzle has the potential to improve thrust characteristics, reduce noise pollution and heat transfer. The particular challenge that HiETA want to focus upon is meeting the structural requirements whilst minimizing weight and managing heat transfer. Specifically, these Nozzles are subjected to high temperatures and pressures and often cannot maintain their shape when compared to circular Nozzles where hoops stresses are matched to the direction of the material.



Thrust Nozzle

Description of the Research and Development approach to produce the final part

HiETA Technologies will be running through a number of design iterations based on improving both the macro and micro design of the Thrust Nozzle. The macro design of the Nozzle is defined as the overall geometry of the Nozzle including its entrance and exit shaping, and ratios along with the profile of the Nozzle length. The micro design includes the integration of optimized lattice geometry for cooling and strengthening. The micro design also includes surface enhancements on the external skin, again improving cooling along with perhaps the aerodynamics of the Nozzle. HiETA Technologies will test a scaled model of the Nozzle on a gas turbine test rig. The dimensions of the nozzle used for this scaled model are approx. 250mmx250mmx270mm.



Different designs using different unit cells and volume fractions

Benefits for HiETA Technologies Ltd

The benefits for HiETA Technologies are commercial benefits through offering an advanced solution to the aerospace customers for Thrust Nozzles with significant improvements to current products. They will also improve their understanding of lattice structures, optimization techniques and mechanical properties of Additive Manufacturing materials.

Project information

The LIGHT project (full title Inspiring New Design Freedoms and Light-Weight Solutions for Metal Additive Manufacturing) is funded by the UK's innovation agency, the Technology Strategy Board. Potential improvements in the economy and performance of Metal Additive Manufacture (MAM) components will be investigated by the use of specialised software. The LIGHT software tool, which will be developed throughout the project, allows the selective replacement of internal geometry by a lattice structure. Thus it is anticipated that the mass and material required to manufacture components will be reduced, whilst maintaining external geometry.

The LIGHT project is being undertaken by a consortium of seven organisations: Delcam Ltd, Bloodhound Programme Ltd, HiETA Technologies Ltd, CRDM/3DSystems Ltd, EOS Electro Optical Systems Ltd, Simpleware Ltd and Magna Parva Ltd. The project runs from the 1st of December 2013 until the 31st of May 2016.

The consortium selected three demonstrator parts:

- *Air Brake Door Hinge (end user Bloodhound SSC)*
- *Thrust Nozzle (end user HiETA Technologies Ltd)*
- *Thermal Protection System for Earth Re-Entry Capsule (end user Magna Parva Ltd)*

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