Qualification Methods for Additive Manufacturing in Space Applications

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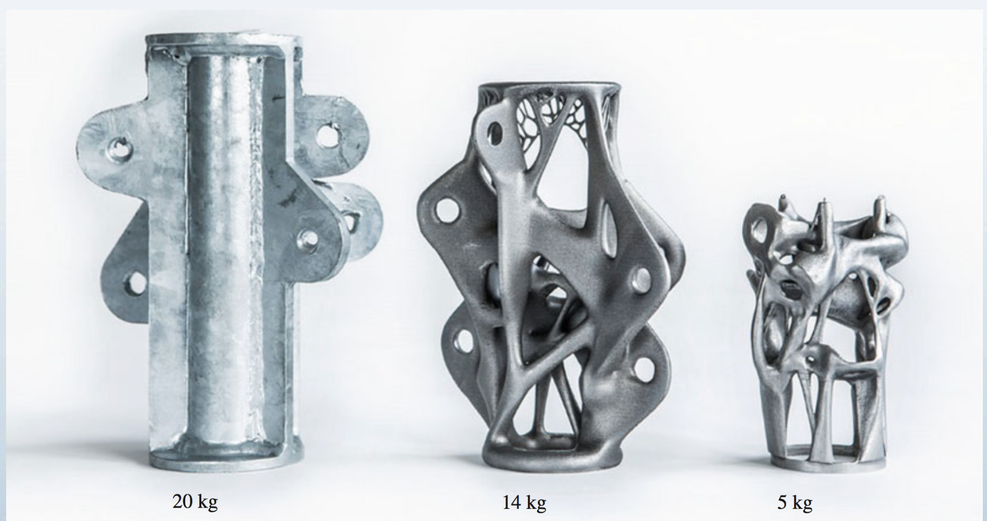
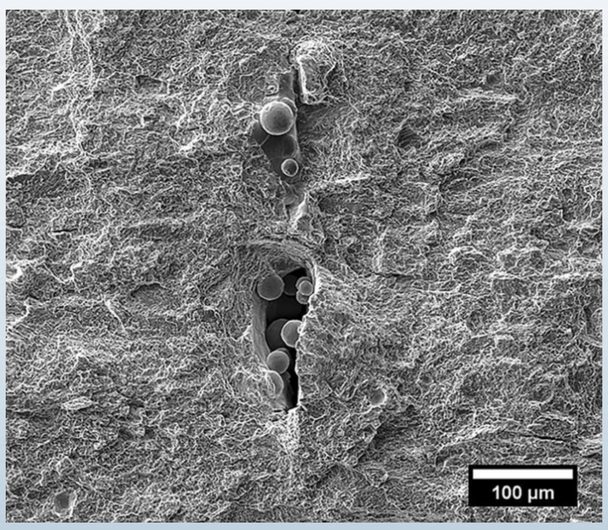
Additive Manufacturing (AM, or metal 3D-printing) is a free-form, layer-by-layer manufacturing technology that gives the user an opportunity to challenge conventional product development. However, AM technologies are new and unstable, rendering variations in the final product. Therefore, methods need to be developed to be able to guarantee the quality of the product (to qualify).

The possibility to design products with complex shapes, optimised topology and integrated functions is alluring for the space industry with its high risk products in low volume production. At the same time, process instability and material defects are impeding the immediate use of AM in mission critical components that are not allowed to fail. Space applications are especially exposed since there is no way to repair or replace damaged parts. A thorough understanding of the AM process's possibilities and limitations is needed to fully utilize them in the development of new and innovative products.

The aim of this research project is to contribute to the industrialisation of AM in space applications by bringing an understanding to the important steps in the qualification of AM products. This will be done by first identifying the challenges with qualifying AM for space applications. Later, changes to the engineering design process will be proposed to facilitate the qualification of AM products. Product quality is a question of understanding the design AND controlling the AM process.



Example of topology optimisation from Ren & Galjaard (2015)



Example of lack of fusion on a fatigue fracture surface from Seifi et al. (2016)

In collaboration with:

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References:
Ren, S., Galjaard, S., (2015). Topology Optimisation for Steel Structural Design with Additive Manufacturing. *Modelling Behaviour, Design Modelling Symposium 2015*, M.R. Thomsen et al. (eds.), pp 35-44.
Seifi, M., Salem, A., Beuth, J., Harrysson, O., & Lewandowski, J. J. (2016). Overview of Materials Qualification Needs for Metal Additive Manufacturing. *JOM*, (January), 1–18.

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