

INTERNSHIP PROPOSAL

Additive Manufacturing with metal powder : Investigation of the effect of the powder on simulation of SLM processes

Cenaero, located in Gosselies (Belgium), is a private non-profit applied research center providing to companies involved in a technology innovation process numerical simulation methods and tools to invent and design more competitive products. Internationally recognized, in particular through its research partnership with Safran, Cenaero is mainly active in the aerospace (with an emphasis on turbomachinery), process engineering, energy and building sectors.

Cenaero provides expertise and engineering services in multidisciplinary simulation, design and optimization in the fields of mechanics (fluid, structure, thermal and acoustics), manufacturing of metallic and composite structures as well as in analysis of in-service behavior of complex systems and life prediction. Cenaero also provides software through its massively parallel multi-physics platform Argo and its design space exploration and optimization platform Minamo.

Cenaero operates experimental facilities in composite manufacturing and prototyping as well as the Tier-1 Walloon supercomputing infrastructure with 14,000 computing cores (see tier1.cenaero.be for details).

The Metallic Manufacturing Processes Modeling group focuses on advanced numerical and physical models for multiphysics simulation tools namely for Additive Manufacturing. Our strategic goal consists in supporting industry for their manufacturing processes development, especially on Selective Laser Melting (SLM) process.

Context

The context of the proposed research work follows the SaPPhIRE collaborative project with Safran that ended in March 2022. At Cenaero, the SLM process can be simulated numerically with high fidelity using a dedicated module (DGAM) of the software ArgoDG which is based on high order Discontinuous Galerkin Finite Element Method.

Objective

The idea of this work is to use the DGAM module for

- Thermal modeling of the SLM process
 - Studying the effect of the powder on the numerical simulation
 - through sensitivity analysis on the powder thermal properties
 - convection factor on the powder boundary
 - the ratio between the conduction in the powder and the raw material
 - different metal powder (e.g., Copper, Aluminum)
 - through sensitivity analysis on the geometrical configuration
 - distance to building plate
 - closed cavity filled with powder
 - distance between facing walls
- Comparative study with experimental data coming from “Centre des Matériaux” (CDM) at “Ecole des Mines ParisTech”
 - Temperature measurements are available
 - One material: Inconel 718
 - Several predefined geometries
 - Thermocouple (probe)
 - Thermal camera (surface temperature field)
- Guidelines:

- In which cases the powder must be included to guarantee an accurate simulation of the process?
- In such cases, how to design the simulation in order to take into account the powder ?
 - Methodologies to define equivalent boundary conditions
 - Homogenized material behavior (no porosity)
 - ...

Duration

The length of the internship is 6 months, e.g., from July 1st to December 31st

Contact

Interested candidates should send a cover letter, and a resume to rh@cenaero.be, including the reference number **BE-IP-2022-002** in the subject."