Master Thesis Proposal

Title: Modelling of 3D printing and AM powders using the Discrete Element Method

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Background

The CAM2 project is a Competence Centre project coordinated by Chalmers IMS focusing on research within Additive Manufacturing (AM). Several research institutes and companies are partners in the consortium spanning the full range of processes, materials, machines, methodologies and simulation capabilities relevant for AM. CAM2 Research Area 5 focus on modelling and simulation of the AM process including modelling of the powder particles, melt pool dynamics, structural deformation, residual stress and the microstructural properties.

This master thesis project relates the modelling of the powder material using a simulation method called Discrete Element Method (DEM). DEM is a method used for modelling and simulation of particulate matter such as soils, powders, rock aggregates, ore materials, grains and many other granular materials. In the current state of development at FCC, a powder model has been developed including a cohesion model that captures the behaviour of van der Waal forces between the powder particles. The model has been implemented and verified in code and the next step is to perform model calibration and validation. The calibration process may be formulated as an optimization problem where the objective is to find the set of model parameters that gives optimal congruence between the experimental and simulation domain. Hence, a good experimental data-set is vital in order to perform such calibrations.

It has been found that the Freemantech FT4 powder characterization device is a good candidate for calibration experiments. This machine is available at the Swerea IVF laboratory in Mölndal. In a previous project, Swerea IVF developed an experimental device for the powder recoating process. This device also provides excellent opportunities for experimental validation of the DEM model in a more AM applied manner than the FT4 device.

As implied the student will work both experimentally and with computational modelling.

Suitable student backgrounds

Mechanical engineering, Physics, Automation & Mechatronics. If you have an interest in ANY of the following topics, this project is for you: material science, computational physics, scientific programming, product development, additive manufacturing, 3D printing.

Joint Project Initiative within CAM2

In order to capitalize on the resources within the CAM2 centre the project is configured as a joint project between FCC, Swerea IVF and Chalmers. This gives the opportunity to utilize the facilities, resources and knowledge regarding both the experimental, simulation and material domains in AM.

The student will have great opportunities to present to and interact within the CAM2 centre including a wide range of leading companies within the field of AM.