

## Moving mesh method in additive manufacturing

Master of Science project

**Introduction** Additive manufacturing (AM) have attracted a significant amount of attention because of its excellent ability of building complex product with few constraints. Anything you can dream up and design in the CAD software, you can create with AM, as shown in Fig. 1 (a) and (b). However, in order to make high quality parts, considerable effort has to be made in setting the appropriate process parameters. Numerical simulation using the standard finite element (FE) or finite difference (FD) method provides a promising way to study the AM process parameters with conducting few experiments. The present project focuses on developing a robust numerical thermal model for selective laser melting (SLM), which is the most common AM technique suitable for producing metal parts. As shown in Fig. 1(c), the materials at different layers are melted by the laser and then joined together after the temperature cools down. High temperature gradients can be observed around the laser spot and hence very fine discretization has to be made in the vicinity of the laser beam for successful FE or FD analysis, as shown in Fig. 2. The moving mesh method is widely used in computational fluid dynamics (CFD), for which the computational cost can be reduced significantly by only giving fine mesh for the region of interest. The aim of the present project is to seek the application of the moving mesh method in the process modelling of SLM.

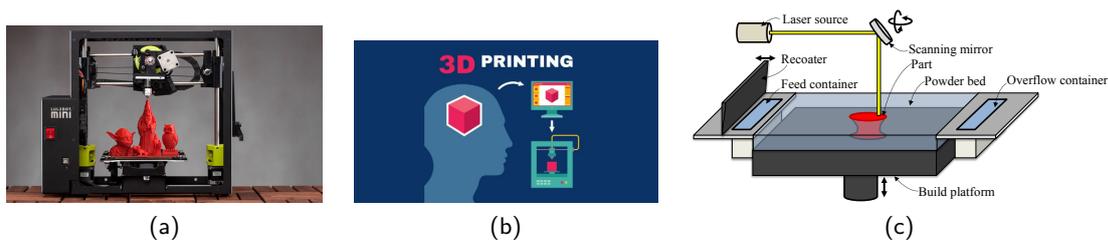


Figure 1: Additive manufacturing (AM) has the (a) excellent ability to build complex product with few constraints and (b) can create anything you can dream up. (c) Selective laser melting (SLM).

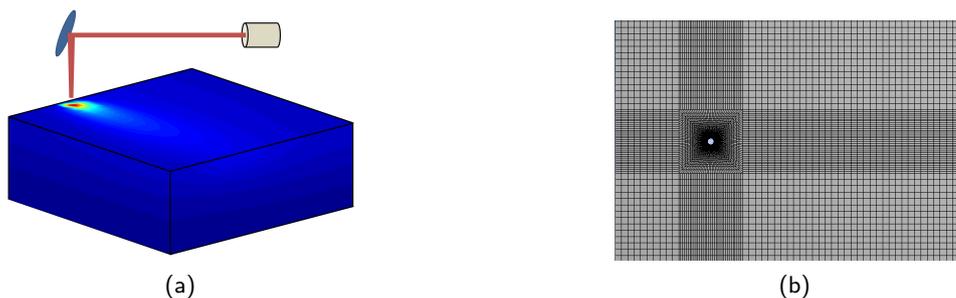


Figure 2: (a) Numerical modelling of SLM. (b) Fine mesh has to be made for the printed part.

**Tasks** Project will focus on the realization of moving mesh method in FD analysis. After surveying the theory of moving mesh method, the student is expected to develop a matlab code to realize the moving of fine mesh along with the movement of the laser. Subsequently, the moving mesh method will be incorporated in a thermal FD model which is already developed by our group to predict the thermal history of the 3D printed parts during SLM process.