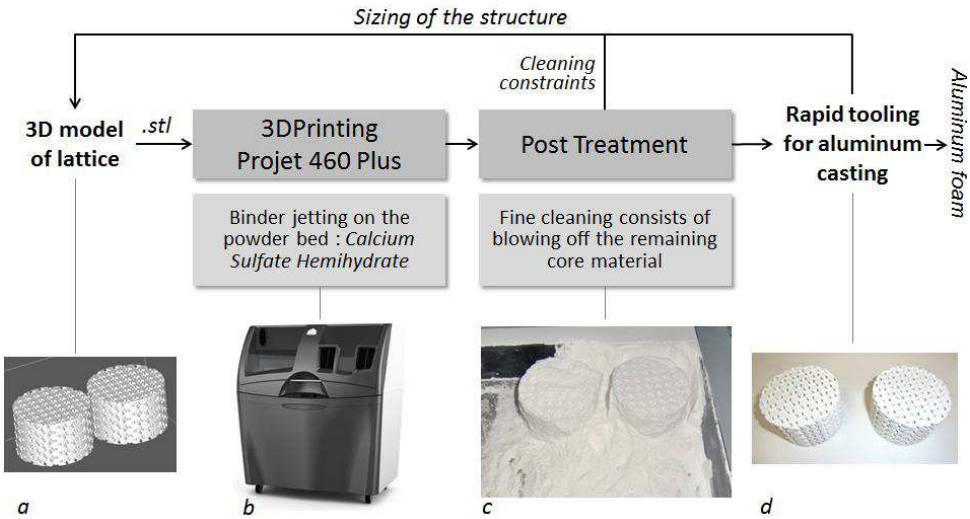
Supervisor: Xiao-Lu Gong - xiao_lu.gong@utt.fr

Co-supervisor: Julien Gardan – julien.gardan@epf.fr

# Study of open-cell foam and its thermal simulation to manufacture a novel structure by rapid tooling (3D printing) and aluminum casting.

This study focuses on the methodology of periodic open-cell composite foams manufacturing by rapid tooling as well as the thermal analysis of the obtained structure. A composite is prepared by introducing a phase change material (paraffin wax) into metal foam. The aim is to provide structural composite foam to study its thermal behavior for the energy storage and achieve an adapted geometry with the help of the rapid tooling by Three-Dimensional Printing (3DP). Concretely, the composite melting process is experimentally studied to determine thermal behavior. In this study temperature variations and distributions of composite are analyzed and compared with the results of pure paraffin. Moreover, the effect of natural convection is analyzed and discussed. a fabrication method of periodic open-cell metal foams is presented, combining the traditional casting method and the 3D printing by plaster and binder jetting. With the help of this method, the morphological and geometrical parameters of open-cell metal foam is designed and controlled according to the manufacturing constraints. After manufacturing the metal foam based on tetrakaidecahedron geometry, the thermal performance of energy storage system is investigated. The final mold in plaster is used like a lost tool through a casting process to shape the aluminum foam. Thanks to 3D printing technology, the mold with different porosities and different structures could be obtained. Combining these molds, the aluminum foams with graded porosity and different designed structures could be prepared by the novel manufacturing method. Besides, their thermal performance and other properties also need further investigation in numerical simulation and more precisely in topological optimization to propose a better structure for thermal distribution.




Manufacturing process of rapid tooling using 3D Printing: a. 3D model in stl format, b. 3D Printer Projet 460+, c. Parts into the powder, d. Final model (mold cavities)