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Fiche Technique de Thèse de Doctorat

Titre de la thèse	**Numerical modelling of residual stresses and distortion of parts manufactured by selective laser melting process**
Filière et spécialité	**Génie Mécanique / Génie Mécanique**
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Résumé	**The ongoing widening of engineering applications and the accelerated technological advancements are showing the limits of conventional manufacturing approaches. To overcome these restrictions in production, non–conventional methods have been developed, additive manufacturing (AM) being a very promising one. Among all its techniques, those possessing metal processing capabilities are particularly suited for industrial applications. In this work, the focus is on the most employed metal AM process, known as laser powder bed fusion or selective laser melting (SLM).** **SLM consists in a deposition followed by progressive melting of metallic powder on a substrate using a high–energy laser beam moving along a predefined scanning path. Once the first step is completed, the build platform is lowered and the cycle continues in a layer–wise fashion until the component is achieved. Despite all the improvements, there are still some serious drawbacks that restrict this technology from reaching its full potential, possibly causing multiple defects in the medium. The most common ones are residual stresses, distortion, cracking, porosity, high surface roughness, as well as the formation of a complex inhomogeneous microstructure of the metal, which lead to reduced mechanical properties and performance.**

	The objective is to predict, through numerical simulation, the manufacturing outcomes in terms of residual stress generation and distortion of SLMed parts. For this purpose, a new, efficient, three–dimensional thermomechanical finite element model is developed. The validation of the model will constitute the next major task in this thesis. An investigation of the influence of the most important process parameters will be carried out in order to reduce the appearance of these defects. Even though the same methodology can be adopted to study all sorts of components such as those in medical, aerospace, and automotive industries, a particular interest is given to the orthopaedic industry, with an implant studied as an application. Ultimately, the goal is to create near–functional parts directly from the AM machine, reduce the time–consuming post–treatment operations in addition to the high costs involved, and contribute in SLM quality enhancement.
Mots-clés	**additive manufacturing, selective laser melting, finite element modelling, residual stresses, distortion, orthopaedic industry**