

Mechatronic approach to the design of AM machines

Paolo Righettini*, Roberto Strada*

* Department of Engineering and Applied Sciences
University of Bergamo
Viale Marconi 5, 24044 Dalmine (BG), Italy
e-mail: paolo.righettini@unibg.it, roberto.strada@unibg.it, web page: <http://www.unibg.it>

ABSTRACT

Any manufacturing process which allows to create a product in its finished form without the need for other machining operations belongs to Net Shape Forming family. Additive Manufacturing (AM) is a part of NSF family; it allows to build 3D objects by adding layer-upon-layer of material (plastics, metals) and includes 3D printing, selective laser sintering (SLS), selective laser melting (SLM), and electron beam melting (EBM).

In order to get good results by the application of these manufacturing techniques, some technological problems has to be faced and solved. They mainly concern: temperature control of the material to be processed, characteristics of the energy source for material transition, control of the power transferred to the material, scanning system's head control, 3D model's layer definition, generation of the laser point's trajectories. All of these aspects have the same importance to guarantee the quality of the product and they are sinergically linked each other. As an example, the power of the energy source and the temperature of the material are strongly related; the power transferred to the material is related to the trajectories running speed; the 3D model's layer definition influences the resolution of the positioning system; on the performances and control of the scanning head, depends the accuracy of the trajectories.

The quality of the product strongly depends on all these aspects as well as on the technical solution to realize them. In other words, the machine implementing the AM technological process is crucial for the product's manufacturing. From the early stages of machine's concept, a multidisciplinary and synergic approach which allows to take into account all the different aspects involved in the process must be followed. This is the typical approach followed by Mechatronics; as a matter of fact, Mechatronics concerns the synergistic application of mechanics, electronics, controls and computer engineering in the development of product and systems through an integrated design approach.

In this paper, the fundamental aspects that must be taken into account in the design process of an AM machine are highlighted, and the used design approach is discussed.

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