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EFFECTS OF MACHINE PARAMETERS ON SPACE COMPONENTS MANUFACTURED THROUGH SLM

Abstract

As additive manufacturing technologies progress within the commercial market and their impact becomes more evident, the need for a clear process definition and control of these innovative techniques becomes increasingly important. Technologies such as Selective Laser Melting of metallic materials are, by now, widespread, in particular in the aeronautics and space domains. The clear advantage compared to conventional manufacturing means becomes evident when the use of additive manufacturing is embedded in the design process: engineers are nowadays able to include complicated features in a single built, significantly reducing the number of involved processes and decreasing the number of parts count. Other clear assets of the new processes include the development of functionally graded materials and parts and the implementation of materials previously notoriously difficult to manufacture in complex shapes and forms.

On the other hand, as more critical parts are manufactured through this technology, criticalities at standardization and quality assurance levels arise. The need of a complete control of the supply chain of powders, manufacturing parameters and postprocesses becomes a crucial step. The task assumes even more importance when considering the recycling associated with the feedstock of an AM process. The recycling of AM powders after the completion of the manufacturing is one of the main convenience associated with SLM, reducing the environmental footprint of the overall manufacturing process as well as noticeably contributing to major cost savings. The recycling of powders, however, introduces various phenomena that increase the criticality of an already high-risk and in development manufacturing process. The number of different variables that intervene and must be considered for the definition of the final product quality is vast and many of them need improved definitions.

This work aims at the definition of the effects of metal powder recycling on the quality of space parts manufactured through SLM. Starting from the definition of the feedstock supply chain, the critical aspects associated to the manufacturing, handling and processing of powders will be considered. A detailed analysis will define the effects of machine process parameters on the part quality. Through a dedicated case study, the analysis will move to the definition of a test specimen for part quality characterization. The specimen will be used for the definition of powder quality characterization criticalities and to monitor the effects on the quality of final printed objects. As a conclusion, the recycling effects on internal features such as embedded channels will be characterized.