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Title

Analysis of Process Parameters Effects on Final Properties of Additively Manufactured Components for Space Applications

Authors

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Abstract

When considering manufacturing for space applications, Additive Manufacturing (AM) stands as a recent technology which has increasingly gained importance in this complex field. AM applications in the space domain have become relevant due to the promise of number of parts decrease as well as design freedom and weight reduction [01]. In particular, the topics of space propulsion and structural components have been impacted: the introduction of satellite and launcher parts built through Selecting Laser Melting (SLM) of metallic materials has paved the way to the implementation of such components in the lifecycle of space products. On the other hand, limitations on this technology are still present, given the recent developments of the technology and the lack of consistent standardization of AM processes: challenges at supply chain level, manufacturing parameters and qualification of components manufactured in metal AM are still under analysis [02].

In this paper, the analysis of the criticalities associated to machine process parameters for metal AM through SLM is considered. The research starts with an assessment of the criticalities associated to this technology on a selected metallic material, Inconel 718, and highlights the need of further developments at supply chain and standardization levels, in particular when dealing with critical components for space applications. Furthermore, effects of the manufacturing process on the final properties of a part are discussed. Starting from preliminary evaluations, a dedicated experimental campaign is set, including a series of different jobs: in these prints, groups of specimens and witness samples, each one printed with a different processing parameter, are retrieved. In particular, the influence of process parameters on the final samples' density, porosity and surface roughness is evaluated. The process parameters which are varied include laser power, scanning speed, hatch spacing while other parameters such as layer thickness and laser focus are considered fixed. These analyses are retrieved for the internal part of the object (body) and are further expanded to the contour of the object: the relations between the two zones are identified through an evaluation of porosities at the border of the two areas. Roughness values are retrieved through the evaluation of inclined surfaces by means of rugosity measures on the external surface of the samples. The data are finally postprocessed, in order to retrieve the effects on the process parameters on the final part properties, and commented.

References

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