A new design for an extensive benchmarking of additive manufacturing machines

This paper focuses on a new methodology for conducting a comprehensive benchmarking of Additive Manufacturing (AM) technologies. The quality of the built products using AM strongly depends on the machine capabilities, and it is thus essential to develop a proper benchmarking design that would allow their comparative evaluation. The benchmarking presented has been designed with the purpose of conducting a comparison between different AM machines, with a particular focus on metal powder-bed AM. The main scope is to make an extensive evaluation of the technologies from multiple points of view, covering: accuracy and precision of the machine, residual stresses on the parts (particularly important in the case of metal AM), homogeneity (in terms of density and residual porosity), build speed, mechanical properties, surface finish and corrosion resistance. For each evaluation criteria, a specific analysis method is employed. The aim of this work is to analyse the current technology capabilities and limitations, in order to assess what different AM machines can deliver in a net-shape process chain scenario. The benchmark is employed for a statistically designed series of experiments to study in detail the AM machine’s real limitations and their working process windows. The design also includes features that represent a challenge for the AM machine, and sometimes exceed the machine’s actual capabilities. Furthermore, the benchmark has been developed to be used as a periodic quality control job for the operational performance of the AM machines.