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Dimensional accuracy analysis of Direct Metal Printing machine focusing on roller positioning errors

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Abstract

Despite of the great deployment of Direct Metal Printing (DMP) technology for additive manufacturing, there is still an issue in the dimensional evaluation of built parts. To establish (or define) a reachable dimensional accuracy value in this kind of technologies is an arduous work due to the wide variety of factors involved. The high flexibility allowed by this technology (regarding geometry, materials, strategies, form and size of the powder particles, post-processing method, etc.) causes a high grade of uncertainty on the final part quality. This uncertainty not only affects the surface roughness or the mechanical properties, but also has a high impact on the dimensional accuracy, and this without considering ulterior post-processes. This paper analyses the geometrical and dimensional accuracy of DMP machines focusing on the positioning error of the leveling roller. Another objective of this survey involves the design and validation of a prismatic test part dedicated to characterize the positioning accuracy of a given DMP printer. The analysis is carried out by determining the positioning errors of the printed geometries according to several printing orientations, both in the directions of the roller (metal dust-feeder) displacement, within the roller itself, as well as in the height direction. The high number of prismatic features manufactured onto the built-up plate, and the uniform spatial distribution of these features, allow for obtaining values of the manufacturing repeatability within the machine working volume, providing the deviations with regard to the nominal model as the variability achievable in the different printing directions.

Keywords: Direct Metal Laser Printing; Additive Manufacturing; GD&T analysis; 3D Printing Accuracy

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