Assessment of Porosity Data of Laser Sintered Polyamide-12 samples obtained by X-ray Computed Tomography using PoD Analysis

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Abstract

Statistical methods have a long history of applications in physical sciences and engineering for design of experiments and data analyses. The Probability of Detection (PoD) is a statistical method used for estimating the chances of detecting a defect. It relates the detectability of the defect to its geometrical characteristic. In this work PoD is used to assess the porosity data obtained by X-ray Computed Tomography (CT) of a laser sintered cube made of polyamide-12. Several different CT scanning parameter sets have been tested, allowing studying the influence of these parameters on the PoD of the defects contained in the microstructure. With prior knowledge of the fact CT signal response correlates with pore sizes [1], our approach, which is a modified version of “a vs â” PoD model [2] is implemented. For this reason contrast-to-noise ratio (CNR) is used as signal response for the PoD model [1]. The approach helps one to understand how the setup parameters affect the detection of the pores. Some of the factors considered for this work are: source power, acceleration voltage, noise reduction and no-noise reduction algorithms used to reconstruct the projections into the voxel model. The PoD analysis leads to the generation of PoD curves and rate of detection curves. Various results obtained are then compared and used to quantify the extent to which our setup could detect the pores.

Keywords: Computed Tomography, Probability of Detection (PoD), Laser Sintering

Introduction

Literature reports several investigations where X-Ray Computed Tomography (CT) has been used to characterize the porosity content of laser sintered polyamide-12 parts [3, 4]. Figure 1 shows the internal microstructure of a typical laser sintered polyamide-12 cubic sample. In this investigation CT is used to gather information about defects’ sizes and local image quality parameters (CNR – Contrast-to-Noise-Ratio) for 16 different CT parameters combinations (see Table 1).

Table 1: CT scanning parameters and noise reduction algorithm levels used to obtain the CT datasets in the first part of the study. * 1500 projections and 1415 ms exposure have been used for all the scans
The information about the defects is extracted directly from the CT-slices, used as input for the PoD algorithm. Figure 2 shows the PoD sequence of steps used to generate the PoD curves. Our approach is compared to that of already existing ones. A typical one is the mh1823 POD algorithm developed by Charles Annis [5].

![Diagram of PoD sequence](image)

**Figure 2: The PoD sequence (Our approach)**

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**References**


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