Structural integrity assessment of AM parts: basic concepts, applications, recent developments.

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Abstract

Despite the disruptive benefits of Additive Manufacturing (AM), the application of this technology for safety-critical structural parts in aerospace is still far to be achieved and standardised. The necessity to comply to very strict reliability requirements is hindering this final step because of the large scatter and low re- producibility always associated to AM, especially in terms of fatigue strength.

In this regards, manufacturing defects are the most important and complex issue, but several other sources of variability have an effect as well. The AM community and the main aerospace industries involved are starting to agree that damage-tolerant approaches are necessary and that probabilistic methods are best-suited to obtain reliable but not over-constrained assessments.

In this paper the basic concepts of 'defect tolerant design' and its application will be briefly exposed, together with the probabilistic concepts of 'extreme value statistics' associated to defect sampling and the assessment of a material volume. The latest developments in terms of a novel computational framework for the probabilistic assessment and the the analysis of 'as-built' surfaces will then be discussed.