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Additive manufacturing of metals — Powder bed fusion (PBF) — In-situ coaxial photodiode monitoring for lack of fusion flaw detection in PBF-LB

Fabrication additive de métaux — Fusion sur lit de poudre — Surveillance par photodiode coaxiale in situ pour la détection de défauts de fusion en PBF-LB

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Foreword

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Additive manufacturing of metals — Powder bed fusion (PBF) — In-situ coaxial photodiode monitoring for lack of fusion flaw detection in PBF-LB

1 Scope

This document provides a workflow comprising experimental procedures and flaw detection algorithms aimed at locating flaws in parts produced during the powder bed fusion-laser-based (PBF-LB) process of metals. It emphasizes the use of coaxial photodiode-based in-situ monitoring and statistical and clustering machine learning algorithms, particularly for detecting lack of fusion-induced flaws. The workflow delineates setting thresholds for statistical detection and determining the number of clusters for machine learning algorithms, utilizing intentional seeded flaws in parts. Validation procedures are provided through computed tomography scanner data. Hardware limitations and considerations for multi-laser processes are addressed, with attention to potential issues.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/ASTM 52900, *Additive manufacturing — General principles — Fundamentals and vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/ASTM 52900 and the following apply:

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
clustering algorithm
unsupervised machine learning methods with unlabelled input data is grouped by similarity

3.2
coaxial photodiode arrangement
type of sensor arrangement on the powder bed fusion-laser-based machine aligned with the laser beam path

3.3
computed tomography
CT
non-destructive examination technique capturing radiographic projections of an object at various rotational angles followed by mathematically reconstruction to produce a three-dimensional volume data set or one or more two-dimensional cross-sectional images

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