Readme- Supplementary data

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Data set title: Supplementary material to publication with the title: *Design Guidelines for Material Extrusion of Metals (MEX/M)*

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Context: This data is supplementary material to the publication with the title '*Design Guidelines for Material Extrusion of Metals (MEX/M)*'

The corresponding paper investigates systematic framework for developing design guidelines for filament-based Material Extrusion of Metals (MEX/M), an additive manufacturing (AM) process classified under ISO/ASTM 52900. MEX/M presents a cost-efficient and sustainable alternative to conventional manufacturing techniques, particularly in the context of rapid prototyping. While AM inherently provides extensive design freedom, the MEX/M process introduces unique geometrical and process-related constraints that must be addressed for optimized component fabrication.

This research formulates and validates design principles for the MEX/M process utilizing an austenitic steel 316L (1.4404) alloy filament. The feedstock comprises a homogeneous mixture of 316L stainless steel powder and a polymeric binder within a thermoplastic matrix, which is extruded and deposited in successive layers. To systematically evaluate the geometric feasibility of MEX/M, benchmark specimens were fabricated, analysing critical parameters such as minimum printable wall thickness, feature inclination, borehole formation, overhang stability, and the resolution of horizontal and vertical gaps. The green-state components, post-fabrication, undergo a two-stage thermal treatment comprising de-binding and sintering at elevated temperatures to achieve near-full densification. The process parameters for fabrication and sintering were adapted from prior empirical studies [1].

A quantitative assessment of geometric deviations was conducted through 3D scanning, correlating the fabricated components with their corresponding CAD models to determine deformation (mm) and shrinkage rates (%). To further validate the practical applicability of the developed guidelines, an impeller was manufactured, incorporating key geometrical constraints intrinsic to MEX/M. As an outcome, this study proposes ten design guidelines that not only reinforce existing best practices but also extend their applicability, contributing to the enhancement of process reliability and structural integrity in MEX/M-based additive manufacturing

Remarks about this dataset:

The first results of process parameters & design guidelines for the MEX/M Green parts were published in the paper https://doi.org/10.15480/882.9046

Dataset Content Overview:

The data set is organized as listed in the folder ***Supplementary-Data-zip.*** The files are highlighted in bold, followed by a concise description of their contents.

1. **Readme-Supplementary data.pdf:** This readme file
2. Documents.zip: ZIP-Folder containing supplementary data
   - **1.1. CAD DATA**
     - 1.1.1. **Design features:** CAD files of various geometrical features used in the study
   - **1.2. Technical drawings:**
     - 1.2.1. Bore holes (BH)
     - 1.2.2. Hallow cylinder (ZH-2mm)
     - 1.2.3. Hallo cylinder (ZH-4mm)
     - 1.2.4. Horizontal overhangs (HO)
     - 1.2.5. Inclined walls (DW)
     - 1.2.6. Supported horizontal overhangs (ÜZ)
     - 1.2.7. Supported walls (WmS)
     - 1.2.8. Tear Drop shape (TD-6)
   - **1.3. MEX gcode**
     - 1.3.1. Bore holes: BH
     - 1.3.2. Cylinder: cylindrical structures
     - 1.3.3. Horizontal bore holes: Horizontally oriented bore holes
     - 1.3.4. Inclined walls: DW
     - 1.3.5. Supported overhangs: Overhang structures with support
     - 1.3.6. Supported walls: Wall structures with support
     - 1.3.7. Teardrop shape 6mm
     - 1.3.8. Teardrop shape 10mm
     - 1.3.9. Teardrop shape 14mm
     - 1.3.10. Unsupported overhangs: Overhang structures without support
     - 1.3.11. Unsupported walls: Wall without support
   - **1.4. 3D Scan data**
     - 1.4.1. Contains meta 3D scan files in .vld2 file format, captured using Keyence 3D scanning technology
     - 1.4.2. Includes scanned samples of all design features in three different processing states
       - 1.4.2.1. Green state
       - 1.4.2.2. Debinded state
       - 1.4.2.3. Sintered state
   - **1.5. Pictures**
     - 1.5.1. MEX as-build samples
       - 1.5.1.1. Contains images of all the design features in green state
     - 1.5.2. Contains screenshots of the images taken from the VL500 software comparison of the 3D CAD comparison with the scan data