

Readme – Supplementary data

Data set title: Supplementary material to publication with title: *On resource efficient and individualized tree support structures for PBF-LB/M by process simulation*

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Context: This dataset is supplementary material to the publication with the title "*On resource efficient and individualized tree support structures for PBF-LB/M by process simulation*" of the Fraunhofer Direct Digital Manufacturing Conference (DDMC) 2025, 12 – 13 March 2025, Berlin/Germany.

The corresponding paper investigates a novel approach combining numerical process simulation with a user-friendly software tool to design resource-efficient tree support structures. A demonstrator part, manufactured from Ti6Al4V titanium alloy, was used to validate the effectiveness of these generative support designs. The accuracy of the process simulation was assessed by comparing numerical results with geometrical displacements, obtained by 3D scanning the additively manufactured demonstrator parts. Additionally, the newly designed support structures were compared against widespread block supports, focusing on material consumption and geometrical precision. The results demonstrate that the presented approach allows for the creation of individualized and efficient support structures, leading to faster print preparation and reduced manufacturing costs. Moreover, new and promising manufacturing limits for thin rods in PBF-LB/M were identified in a parameter study. Overall, the integration of advanced support design techniques shows promise for enhancing the sustainability and cost-effectiveness of PBF-LB/M.

Remarks about this dataset:

- The file “Flowchart_Process_Chain_engl.png” of this dataset was modified and is based on the article “Baumstützstrukturen in der additiven Fertigung” (DOI:10.1515/zwf-2023-1156, published in: *Zeitschrift für wirtschaftlichen Fabrikbetrieb* [11/2023]).
- First results of the software tool were published in the paper “Development of a tree-support software module for PBF-LB/M” (https://wlt.de/sites/default/files/2023-09/Contribution_123.pdf) in the proceedings of the *Lasers in Manufacturing Conference 2023* in Munich, Germany. The software code was copied from a previously existing data set, which is licensed under the *GNU General Public License* and can be accessed under the following weblink: https://dev.azure.com/cenit-dbs/_git/BEST-public

Content of this data set:

The content of the data set is listed below in the same order as the files are stored in the folder *Supplementary_Data.zip*. Files are highlighted with bold font and a short description is given.

- **Supplementary_Data_README.pdf**: This readme file
- **Supplementary_Data.zip**: ZIP-Folder containing supplementary data
 - **3D_CAD_comparison**
 - **Screenshots_Block_Referencing_Test**
 - **Reference_Test_1**
 - **Scan_Block_ReferenceTest1.1.png**: Screenshot of 3D CAD Comparison of demonstrator (Block supports), referenced at another position shown in **Scan_Block_ReferenceTest1_ReferenceLocation.png**
 - **Scan_Block_ReferenceTest1.2.png**: Screenshot of 3D CAD Comparison of demonstrator (Block supports), referenced at another position shown in **Scan_Block_ReferenceTest1_ReferenceLocation.png**
 - **Scan_Block_ReferenceTest1_ReferenceLocation.png**: Screenshot of 3D CAD Comparison showing the reference location of **Scan_Block_ReferenceTest1.1.png** and **Scan_Block_ReferenceTest1.2.png**
 - **Reference_Test_2**
 - **Scan_Block_ReferenceTest2.1.png**: Screenshot of 3D CAD Comparison of demonstrator (Block supports), referenced at another position shown in **Scan_Block_ReferenceTest2_ReferenceLocation.png**
 - **Scan_Block_ReferenceTest2.2.png**: Screenshot of 3D CAD Comparison of demonstrator (Block supports), referenced at another position shown in **Scan_Block_ReferenceTest2_ReferenceLocation.png**
 - **Scan_Block_ReferenceTest2_ReferenceLocation.png**: Screenshot of 3D CAD Comparison showing the reference location of **Scan_Block_ReferenceTest2.1.png** and **Scan_Block_ReferenceTest2.2.png**
 - **Screenshots_with_Reference-Points**
 - **Block_Supports**
 - **Scan_Block_1_Reference-Points.png**: Screenshot of 3D CAD Comparison of demonstrator (Block supports) with reference points
 - **Scan_Block_2_Reference-Points.png**: Screenshot of 3D CAD Comparison of demonstrator (Block supports) with reference points
 - **Scan_Block_3_Reference-Points.png**: Screenshot of 3D CAD Comparison of demonstrator (Block supports) with reference points
 - **Scan_Block_4_Reference-Points.png**: Screenshot of 3D CAD Comparison of demonstrator (Block supports) with reference points
 - **Tree_Supports**

- **Scan_Tree_1_Reference-Points.png**: Screenshot of 3D CAD Comparison of demonstrator (Tree supports) with reference points
 - **Scan_Tree_2_Reference-Points.png**: Screenshot of 3D CAD Comparison of demonstrator (Tree supports) with reference points
 - **Scan_Tree_3_Reference-Points.png**: Screenshot of 3D CAD Comparison of demonstrator (Tree supports) with reference points
 - **Scan_Tree_4_Reference-Points.png**: Screenshot of 3D CAD Comparison of demonstrator (Tree supports) with reference points
 - Screenshots_without_Reference-Points
 - Block_Supports
 - **Scan_Block_1.png**: Screenshot of 3D CAD Comparison of demonstrator (Block supports) without reference points
 - **Scan_Block_2.png**: Screenshot of 3D CAD Comparison of demonstrator (Block supports) without reference points
 - **Scan_Block_3.png**: Screenshot of 3D CAD Comparison of demonstrator (Block supports) without reference points
 - **Scan_Block_4.png**: Screenshot of 3D CAD Comparison of demonstrator (Block supports) without reference points
 - Tree_supports
 - **Scan_Tree_1.png**: Screenshot of 3D CAD Comparison of demonstrator (Tree supports) without reference points
 - **Scan_Tree_2.png**: Screenshot of 3D CAD Comparison of demonstrator (Tree supports) without reference points
 - **Scan_Tree_3.png**: Screenshot of 3D CAD Comparison of demonstrator (Tree supports) without reference points
 - **Scan_Tree_4.png**: Screenshot of 3D CAD Comparison of demonstrator (Tree supports) without reference points
 - **3D-Scanning_process.jpg**: Picture of 3D scanning procedure of demonstrator
- Parameter_study
 - **Parameter_Study.jpg**: Picture of additively manufactured parameter study
- Printed_Demonstrators
 - Block_Supports
 - **Demonstrator_Block_1.jpg**: Picture of additively manufactured demonstrator part (Block supports) with removed supports
 - **Demonstrator_Block_2.jpg**: Picture of additively manufactured demonstrator part (Block supports) with removed supports
 - **Demonstrator_Block_Supports_1.jpg**: Picture of additively manufactured demonstrator part (Block supports) with supports
 - **Demonstrator_Block_Supports_2.jpg**: Picture of additively manufactured demonstrator part (Block supports) with supports
 - Tree_Supports
 - **Demonstrator_Tree_1.jpg**: Picture of additively manufactured demonstrator part (Tree supports) with removed supports
 - **Demonstrator_Tree_2.jpg**: Picture of additively manufactured demonstrator part (Tree supports) with removed supports
 - **Demonstrator_Tree_Supports_1.jpg**: Picture of additively manufactured demonstrator part (Tree supports) with supports
 - **Demonstrator_Tree_Supports_2.jpg**: Picture of additively manufactured demonstrator part (Tree supports) with supports
 - **Adjusted_Parameters_Demonstrator.png**: Screenshot of software tool parameters of the adjusted tree supports for the demonstrator
- Process_Chain

- **Tree_Support_Adjustment.png**: Screenshot of the development from firstly created to adjusted tree supports
- **Flowchart_Process_Chain_engl.png**: Flowchart of the process chain
- Process_Simulations
 - Block_Supports
 - **Simulation_Block_1.png**: Screenshot of the process simulation result (deviations) at the end of the whole process (Block supports)
 - **Simulation_Block_2.png**: Screenshot of the process simulation result (deviations) at the end of the whole process (Block supports)
 - Tree_Supports
 - **Simulation_Tree_1.png**: Screenshot of the process simulation result (deviations) at the end of the whole process (Tree supports)
 - **Simulation_Tree_2.png**: Screenshot of the process simulation result (deviations) at the end of the whole process (Tree supports)
- Results_Scan_Simulation
 - **Deviations_Block_Tree_Simulation_Scan.xlsx**: Excel sheet containing a list with all simulated and 3D scanned deviations of both demonstrator parts (Block and Tree supports) as well as five graphs visualizing the results
- Tree_Support_Software-Tool
 - **tree-software-tool_improvements.pdf**: Text document listing all the improvements and changes done to the software code since the last publication
 - BEST-public
 - **tree_software-tool_README.md**: Read me text file of the software tool
 - code
 - **tree_software-tool.py**: Executable PY-File for the software tool
 - **tree_software-tool_config.conf**: Configuration file for the software tool
 - animation
 - **Tree_Demonstrator_animation.mp4**: Animation of the Tree support generation for the demonstrator part

License:

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