

# SCREENING OF POLYMER BASED AM TECHNOLOGIES

Many different processes are established in Additive Manufacturing (AM). The processes differ from each other in a number of points, partially significantly, such as the required support, build-up rates, resolution, material variety, anisotropy, repeatability, surface roughness, investment costs and much more. These many differences make it difficult to compare the processes and to select a suitable process for a component. In this project, the polymer-based AM will be compared comprehensively and the advantages and disadvantages will be worked out. Based on this, a tool will be developed to support the process selection. This is intended to support persons with no experience in AM as well as those with a great know-how.

## PROJECT OVERVIEW

### DURATION



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### PARTNER



Industrial Consortium of DMRC

### FUNDED BY



### RESEARCHER



Research Leader

Prof. Dr.-Ing. Elmar Moritzer

Research Assistant

Christine Driediger, M.Sc.



### Motivation

There are a lot of different AM processes available on the market. Each process has its own advantages and limitations. These are often process specific and a comparison of the processes is usually not easily feasible. If a suitable process for an application is sought, detailed knowledge of the different processes is necessary. As the technologies differ in so many aspects it is challenging to keep track of them all.

At the DMRC many years of experience in the field of Fused Deposition Modeling (FDM), Laser Sintering (LS) and Arburg plastic freeforming (APF) are available. This will be used in the project to conduct a comprehensive comparison of polymer AM technologies. In addition to the processes comparison, different machine types will be compared where possible. The machines are divided as far as possible into two groups. The desktop printers and the industrial printers.

### Aim

The aim of this project is to give an overview of the technologies and to support the technology selection technologies with a tool. Independent of the state of knowledge about the technologies, the selection tool can be a helpful tool. The tool is used to determine the suitable process considering the numerous technology specific differences. Furthermore, the requirements for the processes and the component properties can be prioritized in the tool. In this way, process selection is made easier, improved and faster.

The screening focuses on the technologies FDM, LS, APF, and Digital Light Processing (DLP). These are the present polymer processes at the DMRC. It is possible to expand this range with further processes like Multi Jet Fusion.

### Process Comparison

The process comparison is primarily based on existing data and experience at the DMRC. The knowledge of the last more than 10 years is to be used and brought into a comparable form. In order to consider as many aspects as possible, several AM experts have already been interviewed and the advantages and disadvantages of the various technologies as well as geometric limitations of the

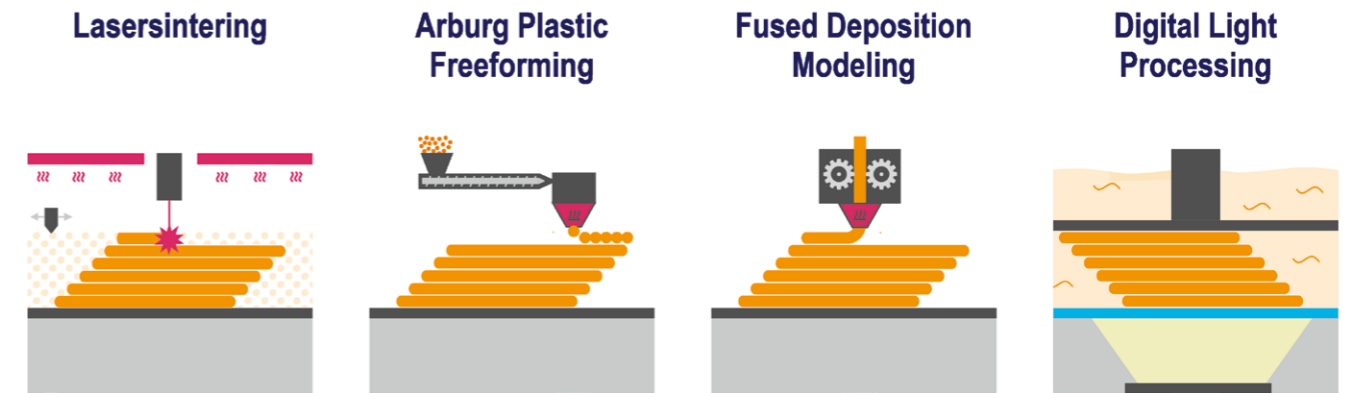


FIGURE 1 Polymer based AM technologies

processes have been collected. All values are to be stored in a material and printer database and then compared.

An important aspect here is the source reference. In the process comparison, numerical values should always be traceable back to the original source. This allows a distinction to be made between data sheet values, values determined experimentally at the DMRC and literature values. In addition, an extension with other materials and printers as well as a correction of existing values should be possible. This offers the possibility that each user e.g. stores own material or printer prices and for the comparison. In addition to the data available at the DMRC, the database is filled with values from a literature research and a small experimental study. The focus of the experimental study is on the geometric capability of the processes according to EN ISO/ASTM 52902.

### Selection Tool

On the basis of the technology comparison a procedure for a process selection is developed. The aim is to create a tool that recommends a suitable process based on the entered requirements.

Possible inputs can be the requirements for the mechanical properties or the accuracy. In addition, it is possible to rank certain properties such as printing costs, printing speed, investment costs, etc. The tool helps to find the best process and shows the advantages and disadvantages of the processes depending on the component to be manufactured.

### Validation

Finally, the entire process selection is to be tested using real components. Suitable requirements are selected and the result

is checked with a selection based on experience. In the case of discrepancies, these are analyzed in detail and, if necessary, the process selection procedure is adjusted. Depending on the DMRC partners input, the real components and requirements will be determined supplemented with further measurements. In addition, the data basis will be expanded and a procedure for selecting a suitable AM Process for an existing component will be developed.