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Application of deep learning tools in prediction of printability of 3D printed tablets

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Fused deposition modelling (FDM) is an additive manufacturing technology that utilizes a 3D design to create an object by depositing molten materials on a platform in a layer-by-layer manner. The feedstock of the FDM printers is called filament and it is created using a hot melt extrusion process (HME) [1]. Although, FDM coupled with HME process has been intensively researched and developed in recent years, printability and various parameters affecting printability is still an unknown field.

The aim of this study was to evaluate influence of mechanical properties of filaments on printability through three-point bend test. The parameters that were observed were maximum force (N), maximum stress (N/mm2) and maximum displacement (mm).

After integrating obtained data for all 90 samples in a data mining environment software RapidMiner Studio version 9.7.0 (Boston, USA) and after analysing it via visual tools (Decision tree model) the correlation between maximum displacement, maximum force and printability was found. It was observed that filaments with the maximum displacement greater than 1.09 mm had a tendency to be printable, while filaments with the maximum displacement bellow this value were not printable. Additionally, if maximum force was lower than 9.61 N, filaments were printable. Otherwise, if maximum force was greater than 9.61 N, even with maximum displacement greater than 1.09 mm, printing was impossible. The method achieved an overall accuracy of 84.85%.

This study showed that the three-point bend test can be successfully used as an initial predictor of printing abilities of obtained filaments.

Reference

1 Basit, A., Gaisford S, eds. 3D Printing of Pharmaceuticals. Vol. 31. 109, Springer (2018)

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