World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:19, No:01, 2025

Optimization of Fused Deposition Modeling 3D Printing Process via Preprocess Calibration Routine Using Low-Cost Thermal Sensing

Authors : Raz Flieshman, Adam Michael Altenbuchner, Jörg Krüger

Abstract : This paper presents an approach to optimizing the Fused Deposition Modeling (FDM) 3D printing process through a preprocess calibration routine of printing parameters. The core of this method involves the use of a low-cost thermal sensor capable of measuring tempera-tures within the range of -20 to 500 degrees Celsius for detailed process observation. The calibration process is conducted by printing a predetermined path while varying the process parameters through machine instructions (g-code). This enables the extraction of critical thermal, dimensional, and surface properties along the printed path. The calibration routine utilizes computer vision models to extract features and metrics from the thermal images, in-cluding temperature distribution, layer adhesion quality, surface roughness, and dimension-al accuracy and consistency. These extracted properties are then analyzed to optimize the process parameters to achieve the desired qualities of the printed material. A significant benefit of this calibration method is its potential to create printing parameter profiles for new polymer and composite materials, thereby enhancing the versatility and application range of FDM 3D printing. The proposed method demonstrates significant potential in enhancing the precision and reliability of FDM 3D printing, making it a valuable contribution to the field of additive manufacturing.

Keywords : FDM 3D printing, preprocess calibration, thermal sensor, process optimization, additive manufacturing, computer vision, material profiles
Conference Title : ICMSE 2025 : International Conference on Mechanical and Systems Engineering
Conference Location : Paris, France
Conference Dates : January 25-26, 2025