Model Calibration in Inkjet Printing Process

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Abstract

Inkjet printing (IJP) is an additive manufacturing process capable to produce intricate functional structures. The IJP process performance and the quality of the printed parts are considerably affected by the deposited droplets' volume. Obtaining consistent droplets volume during the process is difficult to achieve because the droplets are prone to variations due to various material properties, process parameters, and environmental conditions. Experimental (i.e., IJP setup observations) and computational (i.e., computational fluid dynamics (CFD)) analysis are used to study the droplets variability; however, they are expensive and computationally inefficient, respectively. The objective of this paper is to propose a framework that can perform fast and accurate droplet volume predictions for unseen IJP driving voltage regimes. A two-step approach is adopted: (1) an emulator is constructed from the physics-based droplet volume simulations to overcome the computational complexity and (2) the emulator is calibrated by incorporating the experimental IJP observations. In particular, a scaled Gaussian stochastic process (s-GaSP) is deployed for the emulation and calibration. The resulting surrogate model is able to rapidly and accurately predict the IJP droplets volume. The proposed methodology is demonstrated by calibrating the simulated data (i.e., CFD droplet simulations) emulator with experimental data from two distinct materials, namely glycerol and isopropyl alcohol.

Biography of Presenter

Christian Zuniga-Navarrete is pursuing his Ph.D. in the Department of Industrial Engineering at the University of Louisville (UofL). He is currently collaborating with the Additive Manufacturing Institute of Science and Technology (AMIST) at UofL. He received a bachelor's degree in Electronics, Automation, and Control Engineering from Universidad de las Fuerzas Armadas - ESPE in 2020.

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