The Deposition Simulation of Composite Materials via Additive Manufacturing

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Abstract.
Additive Manufacturing (AM) of polymers has become in the last 4 decades a convenient method to obtain mechanical components, with continuously improving performance, shorter lead times and decreased costs, leading to applications in most engineering fields such as Automotive, Aerospace, Naval, Medical, etc. The drawbacks of the Fused Deposition Modelling (FDM) process are thermal stress and strain, due to the cyclic thermal variation during extrusion. Consequently, the precision of the components is inferior to parts obtained via conventional manufacturing technologies. The current study aims to develop a predictive methodology using finite element method for observing the thermal mapping of the process and resulting strain for a high-temperature composite tensile specimen (Nylon-Carbon Short Fibers). The deposition simulation has the objective to recreate the process in Ansys, using the process' technological parameters and the actual trajectory from the FDM equipment, following the process in all its intermediary steps. The numerical data is correlated with the experimental observations, such as thermal captures of the process, or measurements of the specimen after printing. In the end, the methodology of numerical analysis correlated with experimental data enables one to develop complex components from composites manufactured via AM, where dimensional precision plays a significant role.