An Inference Framework to Transfer Thermo-Elastic Properties of Short Fiber-Reinforced Polymers across Different Extrusion Deposition Additive Manufacturing Systems

Abstract

A short fiber-reinforced polymer composite (SFRP) is used in myriad of applications due to its lightweight, and cheaper as well as easier production process in comparison to the continuous fiber reinforced composites. Although traditionally SFRPs are manufactured by injection molding of discontinuous fiber-filled thermoplastic pelletized polymers, recently extrusion deposition additive manufacturing (EDAM) is gaining significant interest in the production of SFRPs due to its capability of manufacturing complex structures with minimal material wastage. More generally speaking, additive manufacturing process has seen a humongous growth in aerospace and automotive industry in the last decade, and in the coming years, even more application of this manufacturing process is anticipated. The growth is expected not only in the number and variety of applications, but also in the number of machines, manufacturers, and available models, which in turn necessitates the requirement of rapid ways of developing material cards or machine codes for these machines. Currently one of the major barriers in widespread use of additive manufacturing technology is the cost and time associated with developing these material cards individually for each type of machines. So, it is important to develop robust information transfer framework between different additive manufacturing printing systems, which will potentially make this manufacturing system more attractive to the users. In this work, an efficient inference framework has been developed to transfer thermo-elastic properties (which plays an important role by influencing how much distortion/shape change an EDAM printed SFRP part experiences) of SFRPs across different EDAM systems. The proposed framework has been validated by comparing experimental observations with numerical predictions for a couple of representative geometries.

Bio

Dr. Gourab Ghosh is an Applications Engineer in the Material Center of Excellence of Manufacturing Intelligence Division of Hexagon in Novi, Michigan, USA. Gourab has over eleven years of experience in research, analysis, and teaching of finite element analysis of composite structures, material modeling, computational mechanics, and structural health monitoring. He has expertise in damage mechanics and crack modeling, composite material modeling, nonlinear finite element analysis of structures, additive manufacturing of short fiber reinforced polymer parts, and reverse engineering to compute material properties. Dr. Ghosh has worked on multiple research projects sponsored by the US Office of Naval Research, the National Science Foundation, the Boeing Company, to name a few. Gourab got his PhD from Vanderbilt University, USA, MS from IIT Kanpur, India, and BS from Jadavpur University, India. Before joining Hexagon, Gourab was working as a Post-Doctoral Researcher at Purdue University, Composites Manufacturing and Simulation Center with Prof. R. Byron Pipes. Dr. Ghosh was a recipient of the prestigious University Graduate Fellowship at Vanderbilt University, and the Prof. ASR Sai Gold Medal at IIT Kanpur, among other awards.

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