Public Abstract
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Title:Development of a Predictive Model for the Design of Parts Fabricated by Fused Deposition Modeling

Fused deposition modeling, or FDM, is a direct digital manufacturing process that is used to rapidly fabricate prototype parts with thermoplastic materials. While rapid manufacturing processes like FDM are currently being used to produce prototypes, various industries are interested in developing these technologies to a degree that would allow for end use parts to be created. FDM is of particular interest for this due to its simple fabrication method and variety of usable materials. To do this, engineering designers must be able to predict the behavior of parts created by FDM. The overall part strength of an FDM part is dictated by the strength of the bonding between filaments. The prediction of part behavior in turn requires the prediction of bond length. The prediction of bond length is completed by combining heat transfer analysis with a bonding model. The results from the bonding equation are validated by comparing the calculated bond lengths with actual bond lengths, which are observed via images obtained with a scanning electron microscope (SEM). According to these images, the calculated bond lengths reasonably predict the actual bond lengths between FDM filaments. In addition, tensile tests are conducted to correlate predicted bond length to observed bond length. These tests also reveal which fabrication parameters have the greatest effect on part strength. Annealing is also performed in an attempt to improve bond length and strength, but is found to be detrimental. Thus, the current work serves as an initial step in modeling part behavior while continuing to refine FDM.