A thermo-electro-mechanical simulation model for hot wire cutting of EPS foam - DTU Orbit (09/11/2017)

A thermo-electro-mechanical simulation model for hot wire cutting of EPS foam

A one-dimensional thermo-electro-mechanical mathematical model describing the effects taking place within a Ni-Cr20% wire used in a hot-wire cutting process for free forming and rapid prototyping of expanded polystyrene (EPS) is investigated and simulated. The model implements and solves three semi coupled non-linear differential equations (the heat diffusion equation, the electrical diffusion equation and the static equilibrium equation) with temperature dependent parameters in order to predict the temperature, kerfwidth, longitudinal stress and displacement, and other process parameters during cutting of EPS in contact with a cutting tool made of an electrically heated metal wire attached to a robot device. The finite difference method is used to solve the coupled equations in the two environments (domains) in which the hot-wire operates, namely air and EPS. The model is calibrated against experimentally obtained data. Novel findings are a transient temperature-dependent kerfwidth prediction and a relation between kerfwidth and the cutting angle as measured from the horizontal direction. These are important relations in the aim for higher geometrical accuracy of the hot-wire cutting process. (C) 2016 Elsevier Ltd. All rights reserved.

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