Predicting plasticity in thermoplastics for aerospace applications with Machine Learning

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ABSTRACT

Nowadays, many mathematical models are available to reproduce the real behavior of new materials such as thermoplastics. There are several constitutive laws for polymers of great interest to the aircraft industry, such as PEEK[1][2], PPSU[3], PEI[4][5], PEKK[6]. In recent years, the need for verification and validation of simulation results gained importance. Nevertheless, the discrepancy between simulation results and real physical behavior is still observed in many cases. Artificial neural networks can help bridge this gap. Machine learning algorithms are well suited to improve constitutive models by directly incorporating experimental data. The present study uses a trained recurrent neural network (RNN) that predicts stress-strain mapping for non-linear material behavior. The data set consists of stress-strain data points for the case of uniaxial stress load from geometry with three elements using FEM. The first training data is obtained from the Ramberg-Osgood equation. Focus is placed on each element stress analysis over time, thus configuring the stress-strain curve. The study is in progress, but preliminary training results are promising concerning the constitutive equation values.

REFERENCES