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Characterization and modeling of discontinuous fiber composites

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ABSTRACT

Composite materials, which are light and strong, are of great interest to engineers in the aerospace industry. Specifically in this work, a discontinuous short fiber reinforced polymer composite whose matrix is Polypropylene and fibers are Electric-glass oriented in different directions was studied. The performance of this material is highly dependent on its microstructure, and therefore the objective of this research is to non-destructively characterize the microstructure of the composite material. This includes characterization of its fiber orientation and length, fiber volume fraction, and void volume fraction. To do this, X-ray micro-computed tomography has been used, providing two dimensional cross-sectional images that stack to form a three-dimensional image of the microstructure. Advanced image-processing methods have been used to determine the fiber volume fraction, the void volume fraction, and the fiber length distributions. Characterization of the microstructure will help predict its mechanical properties and establish a general framework for characterizing and predicting the strength of composite materials. Through the advanced characterization and strength prediction methods discussed in this work, engineers will eventually be able to quickly and non-destructively evaluate materials and thereby reduce large scale testing in aerospace applications.

KEYWORDS

Composite Materials, Discontinuous Fibers, X-ray micro-computed tomography