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PROCEEDINGS

Micro-CT Based Meso-Scale Modeling and Peridynamics Analysis for Short-Fiber Composites

Zhiyang Yao[1], Shuling Wang[1], Yin Yu[1] and Yile Hu[1,*]

[1] Aerospace Structure Research Center, School of Aeronautics and Astronautics, Shanghai Jiao Tong University, Shanghai, 200240, China

*Corresponding Author: Yile Hu. Email: yilehu@sjtu.edu.cn

ABSTRACT

This study presents a method for modeling and analyzing the microstructure of short-fiber composites by using state-based PeriDynamic (PD). The micro-structure of short-fiber composites is obtained from Micro-CT scanning which provides non-uniformly discretized meshes of short-fiber's surface profile. In order to obtain the uniformly discretized PD model, a new layering algorithm is proposed to reconstruct the short-fiber microstructure. Furthermore, considering the anisotropy of short-fiber, a clustering algorithm based on machine learning is introduced to identify fibers and calculate their orientations. The PD interaction domain of a material point on the boundary is incomplete, it can be complemented by searching material points on the opposite side of the microstructure. Hence, the periodic boundary conditions can be naturally satisfied. The bond constants of a bond crossing the fiber-matrix interface is determined by the fiber volume fraction of that particular bond. We prepared short-fiber composites (T300/Epoxy) with 0.5%, 1%, 2% and 5% volume fractions. And the length of fiber composites are 0.5, 1, 2, 3, 4 and 5 mm. Statics tests are carried out on short-fiber composites. The comparisons between peridynamic predictions and experimental results show good agreement, therefore, the accuracy and effectiveness of the proposed method are verified. This method can be used to study the effective elastic properties and damage mechanisms in randomly oriented short-fiber composites under various loading conditions.

KEYWORDS

Micro-CT; peridynamics; short-fiber composites; machine learning; effective elastic properties; damage mechanisms

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