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Thermo-mechanical behavior analysis of 3D braided composites by multiscale finite element method

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Abstract

A new multiscale method was developed for the thermo-mechanical performance analysis of three-dimensional (3D) braided composites. This method is the extended of multiscale asymptotic expansion homogenization (MAEH) method and multiphase finite element (MPFE) approach. The analysis was performed under a representative unit cell (RUC) scale and tow architecture scale. The effective thermo-physical properties of 3D braided composites were predicted. The bending mechanical response under thermal and mechanical loading was determined by the present multiscale finite element method. The effects of braiding angle and temperature difference on the thermo-mechanical behaviors were studied. The three-point bending tests were performed under thermal and mechanical loading and the measured results were compared to the predicted ones to illustrate that the new method is effective and valid for predicting the thermo-mechanical performance of 3D braided composites.

Keywords: 3D braided composite structures; Multiscale; Thermo-mechanical properties; Bending mechanical response

1. Introduction

3D braided composites gains a wide interest due to its excellent mechanical

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