ST107-ICT-005

A Python Script for The Homogenization of Nonlinear Properties of Three-Dimensional Metal Matrix Composites Using Abaqus

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Abstract

Metal Matrix Composites, commonly known as MMCs, have gained popularity and application in different engineering fields due to their good combination of mechanical properties. However, the nonlinear behavior of MMCs under different conditions makes it difficult to predict their mechanical behaviors. Notably, complete methods that fulfil the general modeling requirements of MMCs have not been established yet. This study presents a Python script for the homogenization of nonlinear properties of the metal matrix Aluminum Silicon Carbide using ABAQUS finite element commercial software. The script utilizes the Nonuniform Transformational Field Analysis method (NTFA), which is a widely accepted technique for the homogenization of composite materials on a three-dimensional metal matrix Representative Volume Element (RVE)

and predicts the effective properties under different Periodic Boundary Conditions (PBC). NTFA is based on solving a set of partial differential equations using the finite element method, and the solutions are used to calculate the effective properties of the composite. The main advantage of the script is that it's automated and can be easily modified and applied to different types of MMCs and complex geometries. The results obtained from the study are investigated and found to be in good agreement with experimental data and other existing numerical methods.

Keywords: MMCs; ABAQUS; NTFA; Python; RVE; Plug-in.