# Mechanical and fully coupled thermomechanical FE$^2$ homogenization framework for dissipative periodic composite structures

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## ABSTRACT

Composites are nowadays the leading materials in many applications of various engineering industries (automotive, aerospace, etc.). The excellent multifunctional response that the composites provide is due to their complicated constitutive behavior, which in many cases is unique and exceeds the characteristics of the material constituents composing them. In this regard, and considering the increasing demands of the modern applications, there is an urgent need for new models of high accuracy and efficiency, which are able to properly capture and predict the composites mechanical and/or thermomechanical response under complex loading paths. Well-established phenomenological models fail to achieve this goal due to the strongly anisotropic behavior which composites present and is usually owed to the geometrical microstructural characteristics. Thus, the solution of choosing multi-scale approaches is often mandatory.

In this contribution, a FE$^2$ homogenization framework, considering both mechanical and fully coupled thermomechanical processes, has been developed to study the micro- and macroscopic response of dissipative composite materials with periodic microstructure. The material components from which the composite consists of satisfy the well known framework of dissipative standard materials. Their constitutive law is formulated to consider either pure mechanical or fully coupled thermomechanical processes [1]. Simultaneous calculations at both microscopic and macroscopic scales are performed using the commercial FE software ABAQUS. The mechanical [2] and thermomechanical [3] studies and numerical examples illustrate the framework's capability to account for strongly nonlinear mechanisms (viscoelasticity, viscoplasticity, damage) and complicated microstructural characteristics. The results from the full-field homogenization calculations are compared with those obtained by mean-field micromechanics strategies.

## REFERENCES

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