MICROMECHANICAL CHARACTERIZATION OF QUASI-PERIODIC MULTI-LAMINATED COSSERAT ELASTIC COMPOSITES

Yoanh Espinosa-Almeyda[1], David Guinovart-Sanjuán[2], Reinaldo Rodríguez-Ramos[3,4], Panters Rodríguez-Bermúdez[5], Hector Camacho-Montes[1], César Fidel Sánchez-Valdés[1]
[1]Universidad Autónoma de Ciudad Juárez, Departamento de Física y Matemáticas, Instituto de Ingeniería y Tecnología, Mexico. [2]University of Central Florida, Department of Mathematics, United States. [3]Universidade Federal Fluminense, PPG-MCCT, Brazil. [4]University of Havana, Facultad de Matemática y Computación, Cuba. [5]Universidade Federal Fluminense, Departamento de Ciencias Exactas, Brazil.

Micromechanical models based on Solid Mechanics have been efficient tools for the theoretical study of multiphase composite materials. Their results contribute to materials characterization mechanisms, to define structure-property relationships in new heterogeneous materials with specific geometric properties and conditions, and to the design and optimization of material manufacturing processes. On the other hand, restrictions to periodic geometric microstructures in composite materials imply strong limitations and are not frequent in engineering applications or in nature. A wide range of composite materials with practical applications has non-periodic, quasi-periodic, or even random structures.

In this work, the effective moduli of elastic micropolar composites with quasi-periodic structures are found by the two-scale asymptotic homogenization method (AHM). Constituents are assumed centro-symmetric and isotropic materials and perfect contact conditions are considered at the interface. From AHM, the local problems over the representative cell Y and the corresponding non-null effective stiffness and torque properties are presented. Multi-laminated elastic Cosserat structures are studied considering periodic and quasi-periodic distributions of layers. The quasi-periodic arrangements follow the Fibonacci sequence. Numerical results are illustrated and discussed. The effect of the quasi-periodic laminated structure is noteworthy on the overall effective behavior of the micropolar elastic composite.

Keywords: Asymptotic homogenization method, Centro-symmetric Cosserat elastic composite, Quasi-periodic multi-laminated structures

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Presenting author's email: yoanhealmeyda1209@gmail.com