Research Committee
Aristotle University of Thessaloniki

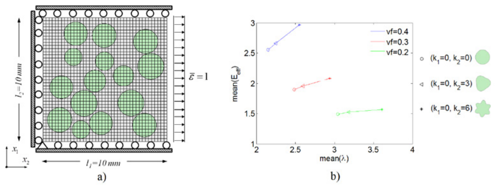
ANALYSIS OF NANOMEMBRANES AND NANOCOMPOSITES BY FINITE ELEMENT AND BOUNDARY ELEMENT METHODS

Short Description

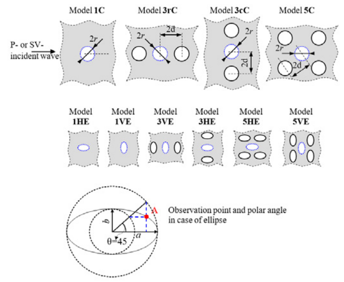
Our work addresses the elastodynamic problem for a finite-sized, elastic solid matrix containing multiple nanoheterogeneities of arbitrary shape, number and geometric configuration. The aim is to evaluate the non-uniform stress and strain fields that develop in the solid matrix and to identify zones of dynamic stress concentration for the case of dynamic loads applied along the matrix boundary. An efficient computational procedure is also proposed for the determination of mesoscale random fields for the apparent properties of nanocomposites using the extended finite element method (XFEM) and Monte Carlo simulation.

Application Field

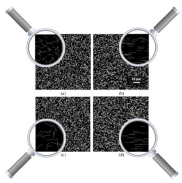
Dynamic response of nano-membranes / Cracks in nano-materials / Piezoelectric phenomena in nano-materials / Optimum design of composite materials with desired mechanical properties based on microstructure / Stochastic analysis of composite structures / aeronautics / precision instruments (isolation of CMM)



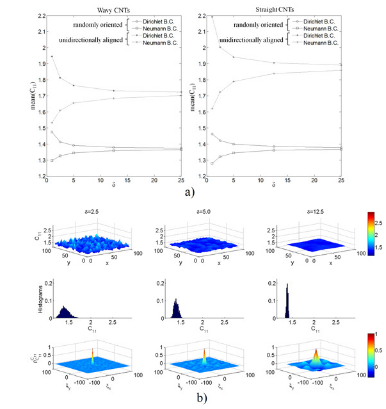
a) RVE of graphene nano-platelet (GnP)-reinforced composite with displacement boundary conditions used in the homogenization process, b) Effect of surface to volume ratio of the inclusions on the mean Eeff of the homogenized material for three cases of inclusion shape and volume fraction vf.



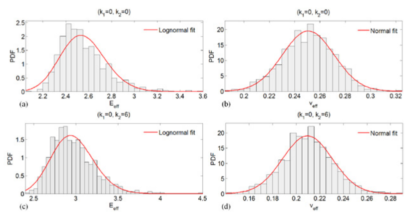
Geometric configuration of the models used in the numerical simulations: Circular / elliptic nanocavities and nanoinclusions



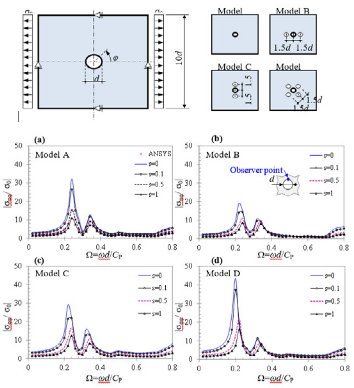
Computer simulated images of random CNT-RCs with 0.2 wt% of (a) wavy randomly oriented (image 1), (b) wavy unidirectionally aligned (image 2), (c) straight randomly oriented (image 3) and (d) straight unidirectionally aligned (image 4) CNTs.



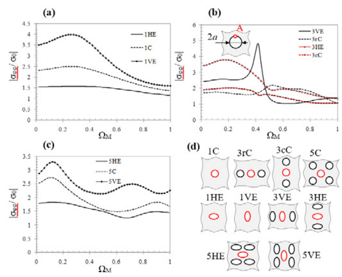
a) Comparison of numerical bounds of apparent property C11 for the composites of images 1, 2 (left) and images 3, 4 (right),
b) Mesoscale random fields for the axial stiffness C11 for the composite of image 1.



Histograms and fitted PDFs of the effective material properties of the random composite (vf = 0.4).



Dynamic Stress Concentration Factor for (a)-(d) cavity Models A-D, at observer point φ=π/2 on the central cavity perimeter



Normalized DSCF vs frequency at observer point A (φ = π/2) along the central circular and/or elliptical nanocavities for a fixed s=0.1 value due to an incident P-wave (θ=0):
(a) Single cavity; (b) three cavities; (c) five cavities and (d) model layout configurations

LABORATORY OF STRENGTH OF MATERIALS AND STRUCTURES
Head of the Laboratory: Professor George D. Manolis (current director since 2016)
Members of the Lab/research team: Alexandros Atahansiou, PhD candidate
T: +30 2310995663 - E: gdm@civil.auth.gr - http://strength.civil.auth.gr/index.html

INSTITUTE OF STRUCTURAL MECHANICS, UACEG
Head of the Laboratory: Associate Professor Sonia Parvanova
Members of the Lab/research team: Petia S. Dineva, Professor, BAS; Georgi P. Vasilev, PhD
T: +359 878589070 - E: slp_fce@uacg.bg - http://www.uacg.bg/?p=109&l=2&id=462

LABORATORY OF STATICS AND DYNAMICS OF STRUCTURES
Head of the Laboratory: Professor Asimina Athanatopoulou
Members of the Lab/research team: George Stefanou, Assistant Professor
T: +30 2310995646 - E: gstefanou@civil.auth.gr - https://www.researchgate.net/profile/George_Stefanou

INSTITUTE OF STRUCTURAL ANALYSIS AND ANTISEISMIC RESEARCH, NTUA
Head of the Laboratory: Professor Vlasios Koumousis
Members of the Lab/research team: Manolis Papadrakakis, Professor Emeritus; Dimitrios Savvas, PhD
T: +30 2107721694 - E: dimitriosavvas@yahoo.gr - https://www.researchgate.net/profile/Dimitrios_Savvas2