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SIMULATION OF CNT COMPOSITE USING FAST MULTIPOLE BOUNDARY ELEMENT METHOD

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ABSTRACT

As composite materials are increasingly applied in engineering, many researchers have studied the simulation of composite materials to estimate the effective material properties. For the effective elastic properties of composite material, a lot of theoretical models are available in literature [1]. To reduce the cost of simulation, representative volume element (RVE) containing only a few fibres is always adopted to simulate the fibre-reinforced composites. Large-scale models with hundreds or thousands of fibres are required in some cases. The fast multipole method [2] accelerated boundary element methods have been proved to have advantages in such large-scale simulation [3, 4]. But in the cases with large ratio of fibre modulus to matrix modulus, such as the case of Carbon Nanotube (CNT) reinforced composite, the results obtained are always not consistent with experimental ones. The reason is that the ideal interfacial conditions are not reasonable for such composites [5].

In this paper, we proposed a RVE with more reasonable interfacial conditions, and a RVE with thin interfacial layer. For CNT reinforced composites, CNTs are treated as effective straight elastic fibres with corresponding high elastic parameters. Effective Young's modulus of CNT reinforced composites are evaluated with different aspect ratio, for both with and without interfacial imperfections, and for the case with thin interfacial layer of medium modulus. Results compared with theoretical models has shown that the developed scheme of fast multipole BEM is promising for large-scale analysis of CNT reinforced composites. Effective elastic properties results, which considered interfacial imperfections or thin interfacial layer, have shown good agreement with experimental results.

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