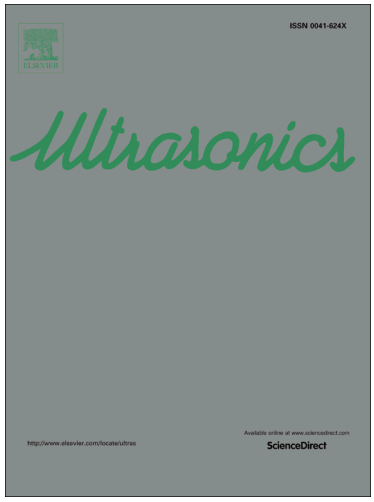

Independent Scattering Model for Evaluating Antiplane Shear Wave Attenuation in Fiber-Reinforced Composite Materials

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Independent Scattering Model for Evaluating Antiplane Shear Wave Attenuation in Fiber-Reinforced Composite Materials

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Abstract: In this work, the independent scattering model is re-constructed using a new method which precisely aligns with the physical mechanism of the attenuation caused by multiple scatterings. Using the multiple scattering theory-based collocation method, extensive numerical simulations are then conducted for nine different fiber-reinforced composite materials. By comparing between the numerical simulation results, the performance of the independent scattering model is highly related to the type of the corresponding single scattering, which has been divided into three categories specified by the directional far-field scattering magnitude patterns in this work. The results show that independent scattering model works well for cases with backward-dominated scattering and overestimates the attenuation for cases with absolute forward-dominated scattering. The independent scattering model also apparently performs better for low concentration problems than high concentration problems regardless of whether the single scattering is the backward-dominated scattering or the absolute forward-dominated scattering.

Keywords: *Independent scattering; backward-dominated scattering; forward-dominated scattering*

1. Introduction

Elastic waves in composite materials are scattered by inclusions (fibers or particulates). To this effect, even if the matrix and inclusions are both elastic, the elastic waves propagating in the composites remain attenuated, which is called the attenuation by scattering. In addition to the scattering effect, elastic waves in composite materials can also be dampened by the viscosity of the matrix and inclusions [1-4]. Even so, this viscosity effect is out of the scope of the current work. For composite materials with randomly distributed fibers/particulates, the wave attenuation associated with a specific configuration of fibers/ particulates is a less interesting research object than the average value over all configurations; this is the attenuation of the so-called coherent wave [5]. Over the past