# ABSTRACT

## THE HIGH FREQUENCY

## VIBRATION OF FIBRE REINFORCED COMPOSITES

Richard A. Bachoo

Fibre reinforced composites (FRCs) form an important class of materials that are used extensively in applications that exploit their high strength to weight and modulus to weight ratios. Structures made of composites can be subjected to random structural excitation that spans a significant fraction of the audible frequency range thereby exciting a large number of higher order modes. The characterization process for the dynamics of such modes in complex structures is termed high frequency analysis. In high frequency problems a stochastic approach instead of a deterministic one is required. Statistical energy analysis (SEA) is the most common tool used for the high frequency vibration problems of complex structures. One critical parameter required by SEA is the modal density.

In this study analytic expressions, independent of boundary conditions, are derived

for the modal density of thin and thick FRC beams cross coupled in bending and torsion. The variation of the modal density with fibre orientation is investigated and it is observed that there exists in every frequency band an orientation that corresponds to a minimum modal density. The variation of the modal energy levels across the modal spectrum is also investigated and it is observed that the incorporation of the FRC beam into SEA is not automatic and only certain frequency bands are suitable to be SEA subsystems. It is also shown that the orientation of minimum modal density can be used within the context of SEA to provide some level of vibration tailoring.

Drive point moment mobilities are derived for certain cases of anisotropic plates and become important in our theoretical SEA modeling of a cantilever beam-plate FRC system. The theoretical SEA model is supplemented by experimental results and both show good agreement. The work herein contributes significantly to the understanding of certain aspects of the high frequency dynamics displayed by composite structures.

Keywords: Richard Bachoo; Statistical Energy Analysis; Fibre Reinforced Composite Beams; Modal Density; Moment Mobility; Anisotropic Infinite Plates;