

Title: Free Vibration Response of Damaged Composite Structures via Refined 1D Models

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Abstract

Damage detection is of primary importance in many structural engineering fields. A proper detection of structural damages is, in fact, required to determine the reliability of a structure. Modal analysis can be a powerful tool in damage detection since structural damages can affect the natural frequencies and modal shapes of a structure. Challenging capabilities are required, since the damage identification has to be carried out from the variations in frequencies and modal shapes detected.

In this paper, damages are introduced in various composite structures and their effects are evaluated in terms of variations in natural frequencies and modal shapes. This work could be considered as a preliminary effort aimed to the creation of a set of guidelines and recommendations on damage effects to be used for damage detections.

Versatile and computationally cheap 1D structural models have been used in this work. These models are based on the Carrera Unified Formulation (CUF) and provide shell- and solid-like accuracies with far less computational costs for a wide range of structural problems, including thin-walled structures and composites. Results show that 1. Damage effects can deeply vary depending on the damage intensity and location, 2. 1D CUF models are particularly powerful tools for this kind of activity since they are able to capture typical behaviors of damaged structures such as the bending-torsion coupling, 3. 1D CUF low computational costs are of particular interest since many analyses are required to create a reliable set of guidelines for the damage detection via modal analysis.