# *Experimental characterization and theoretical modeling of damping properties in CFRP composite structures*

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The increased use of composite materials in modern engineering requires accurate prediction of their dynamic behavior. In particular, damping is a major design constraint in composite structures subject to cyclic loads. While the effects caused by damping are well known, the underlying microscopic mechanisms are still unclear on a quantitative basis. Experimental testing of these phenomena requires some difficulties to be overcome, like the contribution of spurious sources. Besides, several theoretical models of damping have been proposed with different degrees of accuracy.

We consider two of such models representative of the correspondence principle group [1] and the viscoelastic theory group [2], respectively. The first class of models have a simpler theoretical infrastructure with a blunt relation with the underlying physics. Instead, the viscoelastic models are based on the dominance of the viscoelastic behavior of the composite matrix on the dynamic response. Such models lead to a non-linear complex eigenvalue problem that can be computationally heavy to solve.

A modification to the strain energy method is proposed to improve the accuracy to computational load ratio. A testing campaign was conducted on carbon fiber-reinforced polymer (CFRP) composite plates to evaluate the prediction efficacy of the selected models. The following quantities were compared: the frequency response function (FRF), the eigenfrequencies, the mode shapes, and the modal damping. Predictions compare well with experimental results for the simpler stacking sequences (Fig. 1), while some discrepancies arise for the more complex ones. The accuracy significantly increases just at higher frequencies, when computationally heavier methods are employed.

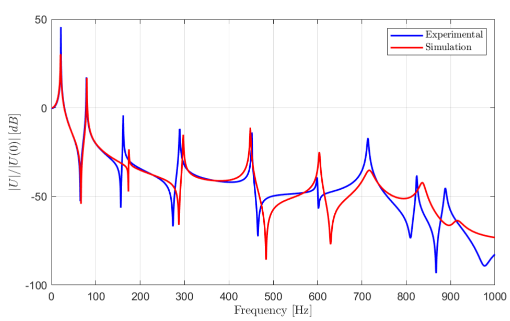


Figure 1: Comparison of the experimental and numeric FRF for the [0°] plate.

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## References

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