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ADVANCED ANISOTROPIC DAMPING MODELING FOR IMPROVED ENGINE DESIGN FOR NVH

Applications of SFRP Oil Sump and Mount Bracket

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Abstract

Small Fiber-Reinforced Plastic (SFRP) materials are often used in the automotive industry to reduce weight and help meet stringent fuel economy and environmental regulations. Compared to metals, the reinforced plastics have superior strength to mass ratio and enable the design of lighter components for the required performance. In some cases, SFRP material can provide an improved performance, in particular when high damping characteristics are required. Knowing this fact, the challenge is to predict this kind of performance accurately with FEA.

The damping behaviour of reinforced plastic materials is locally anisotropic. This anisotropy is inherent to the local fiber orientation, controlled by the injection process. The macro behaviour of reinforced plastics depends on the visco-plastic property of the resin, the elastic or visco-elastic property of the fibers, and the fibers orientation. The mean field homogenization principle, applied to a multi-scale visco-elastic material model used in FEA, allows getting an accurate local prediction of the anisotropic damping behaviour in function of the local fiber orientations. Moreover, this material model accounts for the frequency dependency of the stiffness and the damping. Such model provides an opportunity to optimize the injection process and orient the fibers to maximize the component performance.

This paper presents the application of the multi-scale visco-elastic material model in the FEA simulation of the dynamic response of an automotive engine oil sump and mount bracket. The first part of the paper describes the characterization and calibration of the multi-scale viscoelastic material model; this model is applied in the FEA simulation of the oil sump dynamic response. The predicted results are compared to measured vibrations to assess the level of accuracy. The second part of the paper illustrates the application of the multi-scale viscoelastic material model in the FEA simulation of the engine bracket. This part of the paper discusses the opportunity to optimize the fiber orientation in order to maximize the dynamic performance of the mount bracket.