Dimensional Optimization of a Hybrid Muffler for Better Acoustic Transmission Loss

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Abstract

Parametric model of a production hybrid muffler for tractor engine is developed to compute the acoustic Transmission Loss (TL). The objective is to simplify complex muffler acoustic simulations without any loss of accuracy, robustness and usability so that it is accessible to all product development engineers and designers. The parametric model is a 3D Finite Element Method (FEM) based built in COMSOL® model builder which is then converted into a user-friendly application (App) using COMSOL® Application Builder. The uniqueness of the App lies in its ability to handle not only wide range of parametric variations but also variations in the physics and boundary conditions. This enables designers to explore various design options in the early design phase without the need to have deep expertise in a specific simulation tool nor in numerical acoustic modelling. Parametric studies are conducted to obtain the effect of various design parameters and the results are presented as design guidelines which enables efficient and cost effective design of mufflers for tractor engines. Also, constrained optimization is performed on this model using gradient free method targeting the desired acoustic transmission loss by varying the critical muffler dimensions.