Simulations Based Approach for Optimized Design of a Component to Improve NVH Performance at WOT Condition

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**Abstract**

The Noise and Vibration performance of automotives is critical for overall customer comfort. The Moving vehicle with Vehicle running at WOT (Wide Open Throttle) is common operating condition in driving cycle. Hence it is most common comfort assessment criteria for vehicle design. Simulation and optimization of it in an early stage of product development cycle is priority for all OEMs. In vehicle WOT condition power train is the one of the major source of Noise and Vibrations.

This paper deals with topology optimization technique to yield a new design, location and optimal material distribution for reduction of sound pressure level (SPL) at Driver ear point.

To improve Vehicle NVH performance by adding an optimized component were shape, position and thickness were the design variables in given Transfer Path from Engine Mount to Driver Ear point.

**Purpose:**

Vehicle when it is moving at 60KMPH (standard for WOT) it will have high vibration due to engine load. To predict NVH performance at this condition at pre-production stage with the help of CAE results.

**Introduction**

In this paper we are analyzing Sound pressure level at Driver ear point and to Improve vehicle performance with the help of additional optimized component, where the design variables of the component are defined by shape, position and thickness.

**Process:**

1. Initially we need error free model of NVH performance  
2. Simulation is done of WOT analysis, WOT- Frequency response Function with excitation with Engine load (60KMPH from test data) at Engine C.G and get response at Driver Ear.

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![Fig: Base WOT Result](image-url)
3. With WOT output peak frequency is observed. For detail behavior of structure ODS analysis is performed at Peak frequency. And it is observed the movement of Cowl is very high (which impacts Air cavity).

4. Transfer Path Analysis is done to validate from which MTG location load is transferred to the peak.

![Fig: TPA simulation Result](image)

and it is observed at ENG MTG.

5. As it is important to fix the location of reinforcement, Topology method in OptiStruct solver (which played an important role in optimization) is used for defining the shape, thickness and location of reinforcement.

6. A Solid part assigned with steel property is created in free area of COWL Assy. and attached to adjacent component to withstand the transferred load.

![Fig: Space to place Reinforcement](image)  ![Fig: Component (RED) for Optimization](image)

7. With the given design variables and excitation at ENG MTG, Optimization is performed.
Results & Discussions:

With the Optimized reinforcement simulating WOT condition we reduce SPL at Driver ear location upto 1dB. And also by graph it can be observed that the reinforcement effect not only at peak but also effect various regions at given Frequency range (50Hz~120Hz).

Conclusion:

The Optimized reinforcement satisfies NVH criteria at give frequency range. And it has achieved desired SPL at Driver Ear location. And by a series of iteration with changing DCONSTR more optimized result can be obtained.

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