Optimization of Air Induction System for Acoustic Performance

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Agenda

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- About Air Induction system
- Engine Model Validation
- Build Air Induction System
- Transmission Loss Simulation
- Snorkel Noise Simulation
- Optimization of Air Induction system
- Testing the Optimized Model
- Results and Conclusion
Overview

- Here we discuss the design and optimization of air induction system for better NVH performance.

- 1D model is build and simulated for transmission loss and snorkel noise in GT-POWER.

- Key factors which control the design of air induction system to attenuate the noise are identified during simulation.

- Optimized air induction system model is developed for a chosen engine noise.
About Air Induction system

Air Induction System fulfil a number of roles in an overall vehicle design which are:

- channel air to the engine;
- filter particulates;
- enhance engine performance through wave action tuning;
- reduce noise.

**Engine Performance**
- Clean Air
- Volumetric efficiency

**Air Induction System Design**

**Acoustics**
- Less cabin noise
- Meet Regulatory norms
1D Modeling Flow Chart

Fig. 1D simulation Flow Chart
Engine Model Validation

Engine GT-POWER Model is validated for the following parameters:

- Volumetric efficiency
- Brake power, Brake torque
- Air flow rate, Gas flow rate
- Gas flow temperature and others.

- Air Induction system to be added at throttle entry.
Build Air Induction System

- Two existing designs of air induction system are considered to evolve a better design for a 4 cylinder turbo charged engine.

Design 1

Design 2
GEM3D
Shell Discretization

Shell Discretization

- More Effective way to do acoustic analysis for accurate results at higher frequency
- Time consumed to run the system level analysis is more.

Flow Split Discretization

- Good enough to do acoustic analysis for accurate results at low and mid range frequency.
- Time consumed to run the system level analysis is less.

GEM3D
General Flow Split Discretization
The dirty side, clean side ducts are modelled as pipe components. The air filter box and resonators are modelled as flow split components.
Transmission loss is measured using a non linear transmission loss template.
Snorkel noise is measured using an acoustic microphone placed at the snorkel.
Key design parameters

- Wide open snorkel inlet
- Volume of air box
- Resonator added to dirty side duct, air filter box and clean side duct

Optimized design parameters

- Wide open snorkel inlet
- Volume of air box
The optimized design meets the targets and the samples are tested.
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Order Snorkel Noise for Optimized Design Vs Design 1 and Design 2
Conclusion

• 1D Simulation results are in good correlation with test results.

• Key factors to reduce the snorkel noise are identified with transmission loss and snorkel noise results for the existing designs.

• Design optimization approach detailed here provides best possible combination of air induction system sub components for a chosen engine.

• This effectively reduces time and cost involved in testing several iterations.
Thank You!