RAY W. HERRICK LABORATORIES

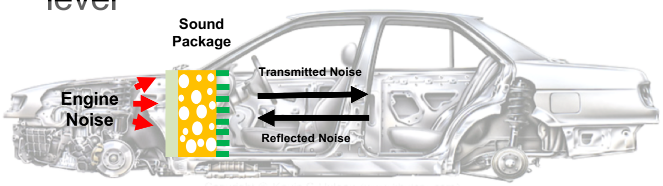
Weight Minimization of Automotive Sound Packages in the Presence of Air Leaks

Hyunjun Shin, Ph.D, ME
J. Stuart Bolton
shin20@purdue.edu

Sponsor: 3M & Ford

Project Description

- To minimize the weight of the sound package for a vehicle
- By reducing the weight of the sound package, it can increase the gas (or battery) mileage beyond the current level



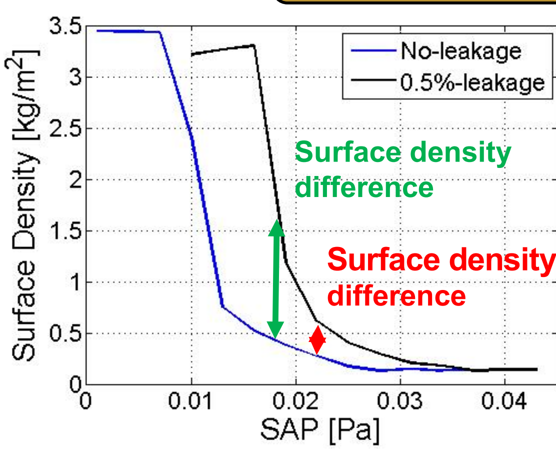
Approach

- Modeling Sound Package (Rigid Panel + Limp Porous Layer + Flexible MPP)
  - JCA Model was used for both the limp porous layer and flexible MPP
- Air path was added in parallel to the sound package
- Acoustic Pressure Calculation Method
  - Transfer Matrix Method was used to calculate the pressure in the cavity
- Quantification
  - Space-averaged pressure was calculated to quantify acoustic performance of the sound package.
- Optimization
  - To find the minimized weight of the sound package, Optimizer using Generic Algorithm was implemented

Discussion

- To compensate for the high frequency transmission performance loss due to the air leakage, the optimized solutions for the 0.5% leakage case converged to a higher surface density as well as flow resistance
- The TL of the sound package improved below 3 kHz, but was reduced at higher frequencies

Results



Very large weight penalty results from even a small amount of leakage (e.g., ~4 x increase in surface density to achieve 0.018 SAP [Pa] (~59 dB)

The surface density in the air leakage case was 0.62 kg/m^2 which in the no-leakage case, it was 0.27 kg/m^2.

A Large Weight Penalty Necessary to Compensate for Leakage and Preserve the Same Sound Package Performance

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