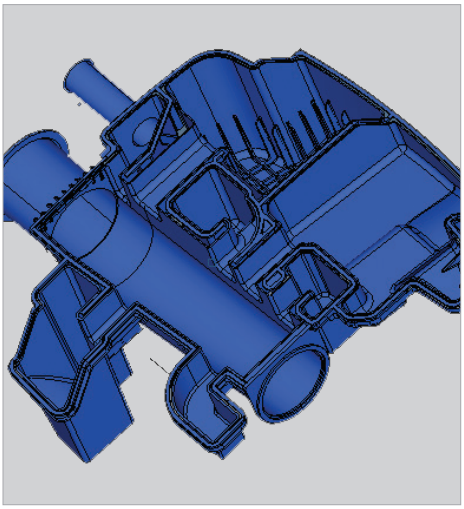
Altair | Partner Alliance

HyperWorks and the Altair Partner Alliance Improve Tuning Frequency Predictions for Induction Systems at Toledo Molding & Die



Key Highlights

Industry
Automotive

Challenge
Tuning Frequency Prediction

Altair Solution
Coustyx, Altair HyperMesh, Altair OptiStruct

Benefits
Tuning frequency predictions within 2% error margin

Overview

From humble beginnings in 1955 as a model and pattern shop to a full service global supplier of air and fluid management systems, along with interior components to the automotive industry, Toledo Molding and Die, Inc. (TMD) has seen the full spectrum of industry evolution. TMD has grown into a global Tier 1/Tier 2 full service supplier of interior and air/fluid management systems. TMD's product lines include molding, assembly and sequencing of interior components and molding and assembly of a variety of air induction, powertrain cooling, front end module, washer and HVAC systems.

The demanding auto industry requires quality production at incredible speeds which is why TMD has a strong core in its people. The employees of TMD, whether production, lab testing or administrative, have a singular goal to achieve the highest levels of customer satisfaction, solidifying long-term relationships and building new connections. Listening to the customers' voices and demands of the industry has established TMD with a global reputation of quality, innovation and discipline.

TMD feels privileged to be serving such an important and dynamic industry and appreciates its customers and collaborative partners for giving them the opportunity to do business with them, not to mention, the confidence they place in the people of TMD every day. The foundation of their success is a teamwork focused approach based on an open line of communication with their employees and customers and their dedication to accomplishing a common set of goals.

TMD is committed to compliance with applicable regulations and other subscribed requirements. Employees strive for

Keywords: HyperWorks, Coustyx, APA, CAE, Automotive, Transmission Loss

Toledo Molding & Die Success Story

“The ability of Coustyx to predict the tuning frequency within 2% error margin helps us retain excellent product quality before production. With the confidence in simulation, we avoid the cost of prototyping parts and accompanying testing is circumvented as well.”

Karthik Jayakumar
NVH Engineer
Toledo Molding and Die, Inc.

continuous improvement and are passionate about the environment. They work to uncover opportunities for improvement concerning the environment, waste minimization, pollution prevention and hazard reduction related to the environmental aspects.

The Challenge:

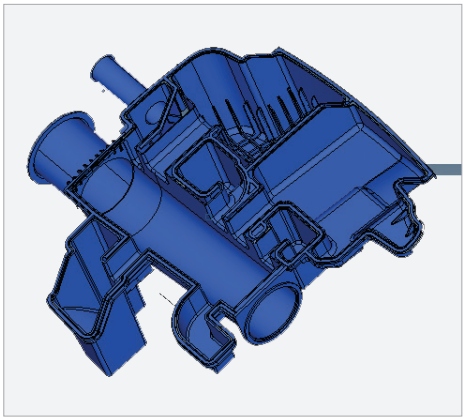
TMD's advanced engineering group provides simulation support for every product line employing FEA, CFD or BEM simulation techniques. Their main objective is to improve product quality by performing simulations beforehand to minimize prototyping and testing costs. The group also establishes new simulation methodologies to limit the amount of testing required to meet design requirements which is achieved by confirming excellent test-simulation correlations.

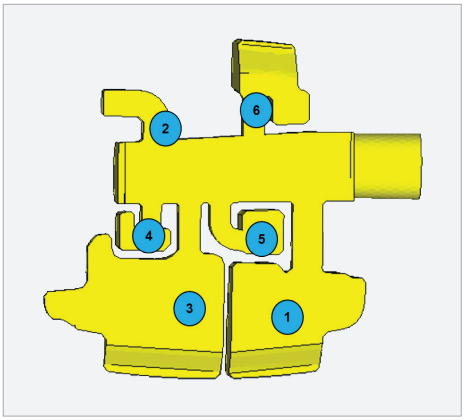
The advanced engineering group preforms transmission loss simulations to identify the tuning frequency of each side branch Helmholtz resonator or quarter wave tuner in an induction system. An induction system provides air intake for an engine. Similar to the exhaust system of an engine, the intake must be properly engineered and tuned to provide the greatest efficiency and power while simultaneously meeting noise requirements. An ideal induction system should increase the velocity of the air until it travels into the combustion chamber, while minimizing turbulence, restriction of flow and noise at the induction inlet.

Induction noise is caused by the pressure differential created between the inlet port and the cylinder cavity when the piston descends during the intake stroke. The overall induction noise is a combination of several sinusoidal components known as orders. Engine orders are simply the amplitude of the frequency components which are the multiples of the rotating frequency. In order to meet the noise target at induction inlet, resonators are built into the induction system targeting particular frequencies. These frequencies are dependent on the resonator's dimensions such as the volume, resonator neck diameter and length.

The frequencies of the induction system are chosen based on the dyno testing at a customer site and are dependent on the tuner dimensions. The target frequency needs to be achieved with a high degree of accuracy in order to meet the acoustic requirements for the induction system.

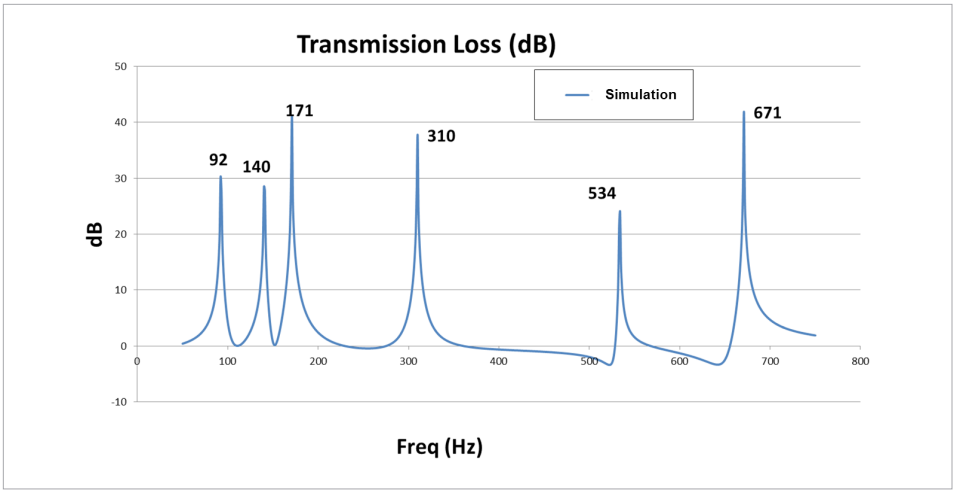
Even though the designer packages it according to provided dimensions based on theoretical formulae, there have been circumstances where the theoretical calculations did not match the test data.





Description	Test Frequency (Hz)	Predicted Frequency (Hz)
Resonator1	95	92
QWT2	660	671
Resonator3	140	140
Resonator4	520	534
Resonator5	310	310
Resonator6	165	171

Predicted vs. Test Frequencies for each Resonator in the Induction System



Transmission Loss vs. Frequency using Simulation for Outlet

Induction System Outlet

The formulae don't take into consideration several factors such as the effect of the shape or dimensional inaccuracies across the tuner that arise during the CAD process. TMD turned to CAE to improve tuning frequency predictions for the resonators in an effort to more closely match tuning frequency predictions to the actual test frequencies.

The Solution:

TMD employs computer-aided engineering when performing transmission loss simulations. One of the software packages the engineers use is Altair's HyperWorks suite, especially HyperMesh for pre-processing, HyperView or HyperGraph for post-processing and OptiStruct for optimization tasks. In addition to the HyperWorks suite, TMD uses Coustyx by ANSOL via the Altair Partner Alliance to run acoustic simulations and predict the tuning frequencies.

Coustyx is a next generation analysis software that integrates Advanced Boundary Element formulations with Fast Multipole Method to yield fast, accurate solutions to very large problems in acoustics across a wide frequency range.

For the transmission loss simulation covered in this story, TMD uses HyperMesh for pre-processing to create both a fine mesh meeting the quality requirements for CFD simulation and a coarser mesh for the acoustic simulation. A NASTRAN format output is created in HyperMesh which is then used as an input for Coustyx. Necessary skinning of the surface mesh is performed in Coustyx and with the assignment of boundary conditions, a transmission loss simulation is performed.

With the APA, customers can access third party solutions such as Coustyx via their HyperWorks licensing pool without additional charge. This offers great flexibility in software usage, especially when applying tools that are not used every day.

Conclusions and Outlook:

Coustyx considers both the shape and size of the cavity inside the resonators when predicting the tuning frequencies. “The ability of Coustyx to predict the tuning frequency within 2% error margin helps us retain excellent product quality before production. With the confidence in simulation, we avoid the cost of prototyping parts and accompanying testing is circumvented as well” explained Karthik Jayakumar.

Out of the HyperWorks suite, TMD uses HyperMesh for modeling as well as HyperView or HyperGraph for visualization depending on the simulation output. OptiStruct is used for optimization purposes ranging from topology, topography to gauge. TMD uses Coustyx, nCode DesignLife and Maple software via the Altair Partner Alliance.

Access to the APA software suite has given TMD the ability to evaluate software for an indefinite amount of time without actually owning the software. They get the most out of their HyperWorks Units by utilizing HyperMesh during work hours and running Coustyx or other partner software over the weekends or for a quick end of the day run to help keep costs down. They have been working with Coustyx support to expand the transmission loss simulation capability to other applications. There is currently excellent test-simulation correlation for tuner frequency prediction but TMD would like to expand it to magnitude prediction as well. TMD is always exploring the APA's software offering to see what else may be useful to them.

Visit the HyperWorks library of

Success Stories

at www.altairhyperworks.com

About Altair

Altair is focused on the development and broad application of simulation technology to synthesize and optimize designs, processes and decisions for improved business performance. Privately held and headquartered in Troy, Michigan, USA the company operates globally to serve customers in a diverse range of industries including automotive, aerospace, defense, meteorology, architecture and construction, energy, electronics, and consumer goods.

www.altair.com

About Altair Partner Alliance

One Platform. One License. One Source. **All Access**.

Altair's HyperWorks platform applies a revolutionary subscription-based licensing model in which customers use floating licenses to access a broad suite of Altair-developed, as well as third-party, software applications on demand. The Altair Partner Alliance effectively extends the HyperWorks Platform from more than 20 internally developed solutions to upwards of 60 applications with the addition of new partner applications. Customers can invoke these third-party applications at no incremental cost using their existing HyperWorks licenses. Customers benefit from unmatched flexibility and access, resulting in maximum software utilization, productivity and ROI.

www.altairhyperworks.com/apa

Altair Engineering, Inc., World Headquarters: 1820 E. Big Beaver Rd., Troy, MI 48083-2031 USA
Phone: +1.248.614.2400 • Fax: +1.248.614.2411 • www.altair.com • info@altair.com