Case Study: **Scania Bus**

Increase Commuters' Comfort Thanks to New Actran NVH Capabilities

Based on an interview with Per-Olof Berglund, Senior NVH CAE Engineer at Scania Bus

Overview

Numerous cities around the world are facing changes in the way urban transportation is considered. The need for lower particle emissions and for a safer and quieter environment are key concepts shaping the future of mobility. Among sustainable transport system enablers, recent technological progresses in electric and autonomous vehicles are accelerating user adoption.

Designing electric and autonomous vehicles is a challenge for the NVH design and engineering teams that need to cope with increasing acoustic comfort expectations while dealing with new noise sources and structural designs.

For Scania, a world-leading provider of transport solutions, the acoustic comfort of drivers and passengers has always been of great importance in the design engineering process. Not only is a pleasant drive critical for buyers or commuters, but it also impacts health and productivity. Scania is focused on getting their vehicles up to speed with today's acoustic expectations by addressing the level and quality of vehicle interior noise. The development of increasingly optimized NVH properties is supported by extensive testing and by the introduction of new methods based on vibro-acoustic simulations. In this endeavor, the calculation team at Scania Bus decided to use the new capabilities of Actran Virtual SEA approach to assess the vibro-acoustic performances of their design at mid- and high frequencies.

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Per-Olof Berglund, Senior NVH CAE Engineer at Scania Bus

Challenge

Buses are a cost-effective solution for urban transportation, combining reliability and uptime with low environmental impact through a wide range of engines, including hybrid architecture. Simultaneously delivering an efficient transportation platform and a pleasant environment for both passengers and drivers is a challenge. When it comes to interior NVH comfort, multiple factors are driving the final interior sound and vibration levels. On one hand, the human body sensitivity to vibrations requires investigations and predictions at low frequencies. In these frequency ranges, road and powertrain excitations are mainly responsible for complete body vibrations. On the other hand, ancillary units produce noise at much higher frequencies where human ears are more sensitive, requiring focus on these frequency ranges too. Finally, the interest in electrified powertrain is increasing not only in the car industry, but also in public transportation, where these solutions are being adopted and new excitations with a higher frequency content are therefore being created.

Key Highlights:

Product: MSC Nastran, Actran

Industry: Automotive, Ground Vehicle

Challenge: Interior NVH Comfort at High Frequency

Solution: Actran SEA – Virtual SEA approach relying on existing low frequency Finite Elements models

MSC Software Solution

In order to cover a wide range of frequencies, the calculation team at Scania Bus is investigating on the most suitable approach to answer their new requirements while valuing computational expertise in Finite Elements (FE) modeling and related existing FE models.

From FEA to SEA

“With Actran Virtual SEA approach, our existing FE models can be re-used, this is the best situation for us”, explained Per-Olof Berglund, Senior NVH CAE Engineer at Scania Bus. With Actran SEA module and its Virtual SEA approach, CAE engineers can indeed use their existing Finite Elements vibro-acoustic models (mode shapes and eigen values) to create a SEA model. There is no need to access experimental or analytical expressions to build a SEA model.

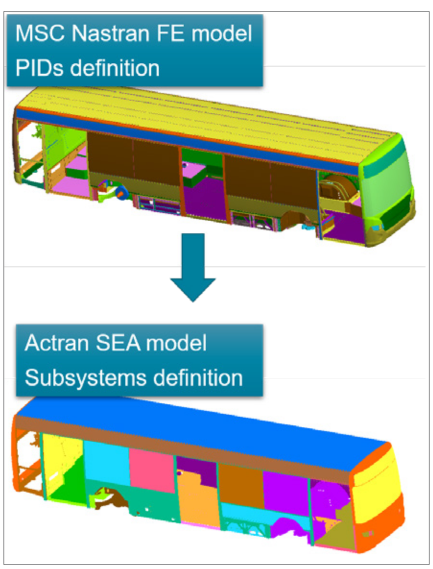

Figure 1 - MSC Nastran FE and Actran SEA models overview

Vibro-acoustic prediction

An entire vibro-acoustic SEA model of a bus is built using structural and acoustic modes extracted in MSC Nastran. Subsystems, defining the subdivision needed to build the SEA matrix, are defined inside the graphical user interface of Actran and based on FE PIDs and materials and shapes of structural parts.

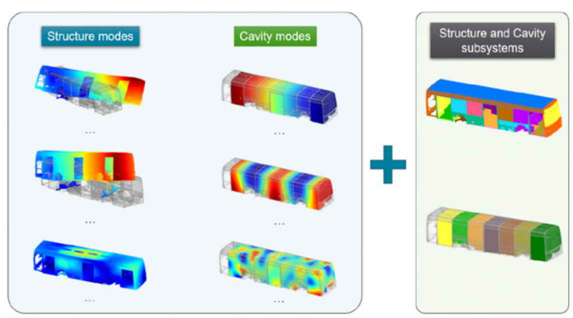

Figure 2 - Required inputs for Actran Virtual SEA model creation

Thanks to this approach, Actran offers a smooth transition from existing low/mid- frequency responses to mid- to high-frequency ones. This allows engineers to value their work and guarantees a safe SEA model building without any constraints on geometrical objects.

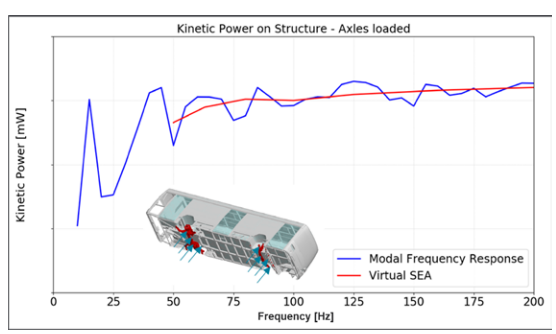

Figure 3 - Structural powers on entire bus structure - Modal Frequency Response (blue curve) vs. Virtual SEA response (red curve)

Thanks to its extrapolation capability, Actran computes SEA matrix parameters at high frequencies in a reduced timeframe. Energy levels, kinetic energies and mean sound pressure levels are obtained over the complete frequency range of interest.

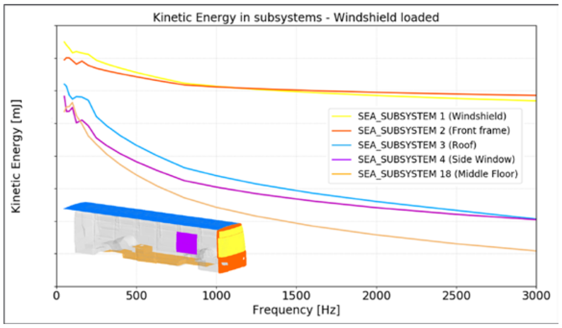

Figure 4 - Kinetic Energy on bus subsystems - Extrapolated results

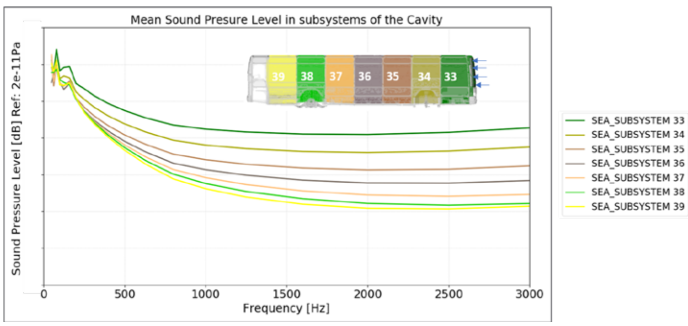

Figure 5 - Mean Sound Pressure Level in Acoustic Subsystems - Extrapolated results

Transfer Path Analysis

Among the different Actran SEA outputs, it is possible to visualize the transfer of energy between the different subsystems. This equivalent Transfer Path Analysis is interesting for engineers analyzing how vibrations propagate into the different parts of the structure. By selecting a subsystem of interest, the user can visualize the main frequency-dependent contributor to energy creation on the selected subsystem for different loading conditions.

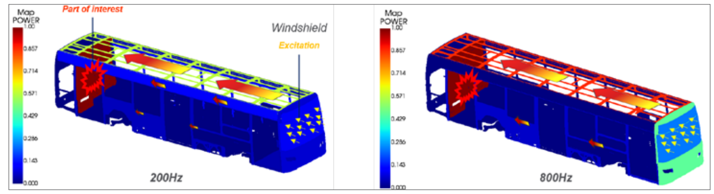

Figure 6 - Transfer Path Analysis at 200 Hz and 800 Hz from excited structure part (windshield) towards part of interest (bus back wall structure)

About Scania

Scania is a world-leading provider of transport solutions. Together with its partners and customers, they are driving the shift towards sustainable transport systems. In 2018, they delivered 88,000 trucks, 8,500 buses as well as 12,800 industrial and marine engines to customers. Net sales totaled over SEK 137 billion, of which about 20 percent were services-related. Founded in 1891, Scania now operates in more than 100 countries and employs some 52,100 people. Research and development are concentrated in Sweden, with branches in Brazil and India. Production takes place in Europe, Latin America and Asia, with regional production centers in Africa, Asia and Eurasia. Scania is part of TRATON GROUP. For more information, visit: www.scania.com.

For more information on Actran and for additional Case Studies, please visit:
www.mscsoftware.com/product/actran-acoustics

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