Using MSC.Actran for Predicting the Sound Transmission Loss of Trim Panels

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Alpha Diallo, Renault
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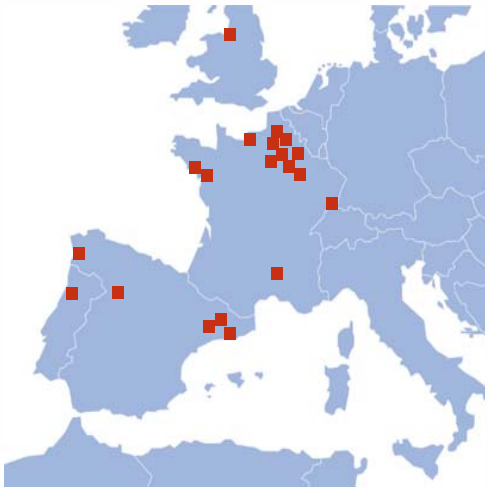
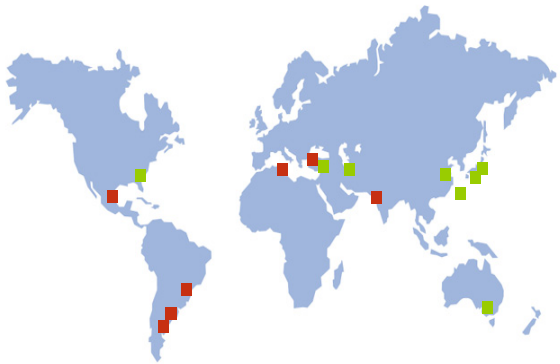
Trèves



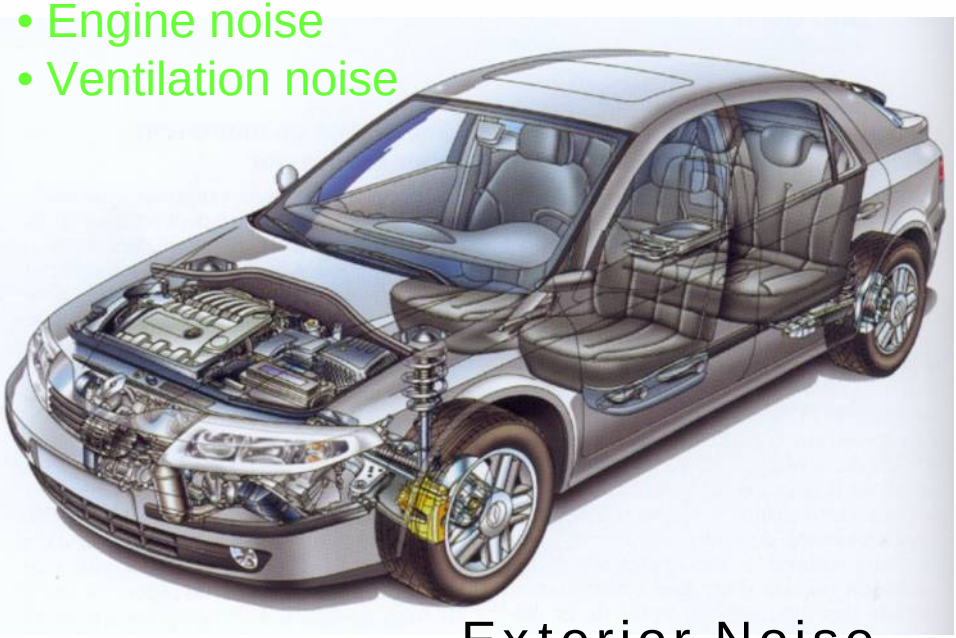


- A family owned Company since 1836.
- 100% automotive turnover with 900 million Euros in 2002.
- A world class interior trim specialist.
- A vertical integration from raw materials to final products.
- A system supplier & integrator.
- 7,000 employees worldwide.
- 7% of turnover dedicated to Research & Development.
- A R&D center located in Reims and founded in 1993: CERA.
- A strong continuous growth.
- A strategic global presence to offer a better service to our customers

Renault

Interior noise

- Aerodynamic noise
- Booming noise
- Engine noise
- Ventilation noise



Exterior Noise

- Engine noise
- Exhaust noise
- Intake noise
- Tyre/Road noise

Missions of the Acoustics Research Group

- To improve acoustical performances thanks to understanding and simulation of physical phenomena, and perceptive aspects
- To define new technical systems
- To lead the technical watch

Key figures

20 people working on vibro-acoustics, psycho-acoustics, aeroacoustics
20 Unix stations + access to Renault's super computers
2 rooms for measurements + 1 listening room + access to Renault's test tracks
3 European projects ongoing (InMAR, MADUSE, RoTraNoMo)

About Free Field Technologies

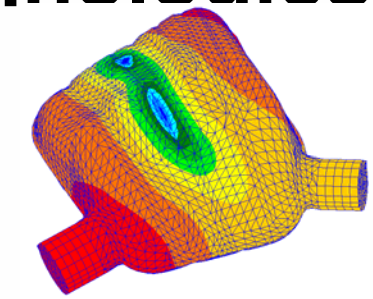
Acoustics, vibro-acoustics, structural dynamics, …

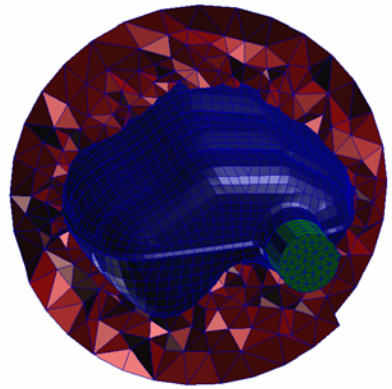
Products:

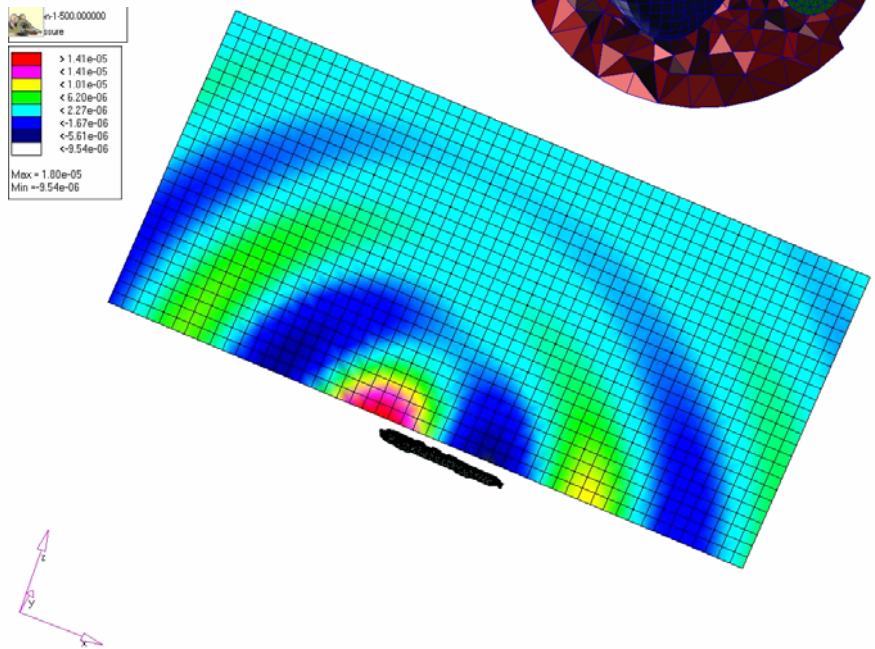
- MSC.Actran (vibro-acoustic)
- Actran TM, Actran LA (aero-acoustic)
- MSC.Nastran Krylov solver

But also:

- Engineering services
- Specific developments
- Training and technology transfer





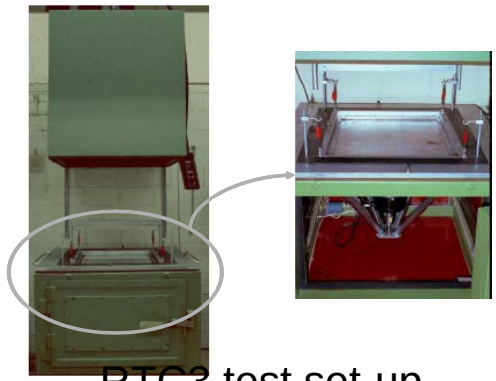


Introduction

The modeling of vehicle trim components is more and more necessary for improving the vibro-acoustic performance of a car.

Trim efficiency has been tested for a long time on flat panels (RTC3 test). Different numerical methods exist to model flat panels.

This paper aims to study complex and realistic structures (curved panels, varying treatment's thickness) and to highlight physical effects due to the structure's curvature and the multiple foam thicknesses



RTC3 test set-up

TL box for curved panels

Industrial interest for trim modeling

- To improve our knowledge in acoustics for insulating parts
- To create numerical models of the *cut-body method* in order to get the transmission loss (TL in dB)
- To define and optimise the sound package early in the project, in order to follow the customer acoustic target
- To improve the acoustical specifications

Contents of this presentation

Two different sandwich structures (steel, foam and a heavy layer) considered:

- Multi-layered curved panel
- Multi-layered panel with different foam thicknesses

Constitutive materials manufactured by Trèves (trim supplier)

Transmission loss of various configurations will be computed using MSC.Actran

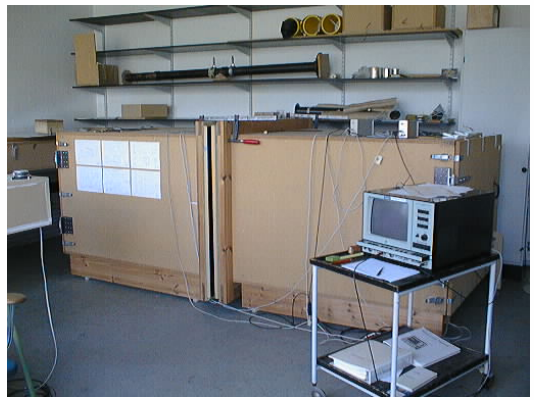
Results will be presented and compared to measurements and/or other results (SEA).

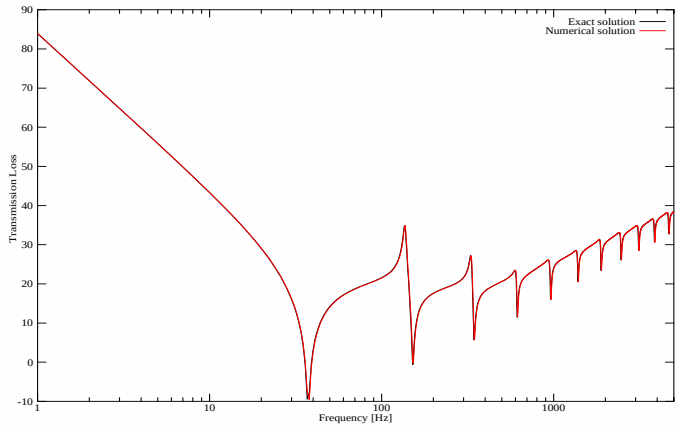
Numerical method: MSC.Actran

Actran = ACoustic TRANsmission

Finite and infinite elements :

- Visco-elastic and poro-elastic medium : finite elements
- Fluid medium : finite and infinite elements



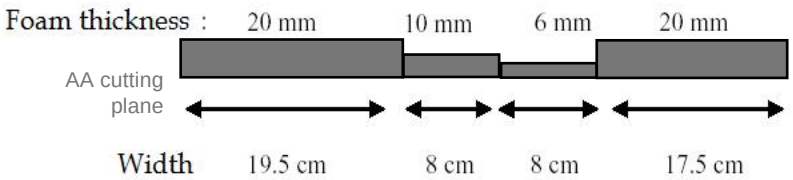


TL of a plate up to 5kHz
Analytical (black) and Actran (red) solutions

Studied structures

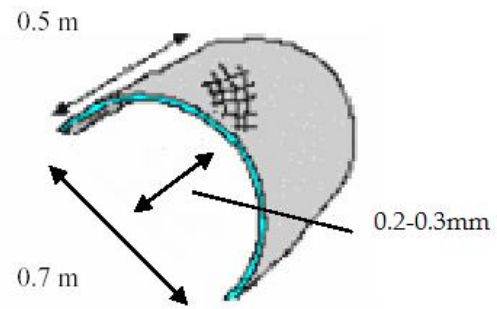
Multiple thickness

- 8mm steel
- 6-20mm foam
- heavy layer (3.82 kg/m²)



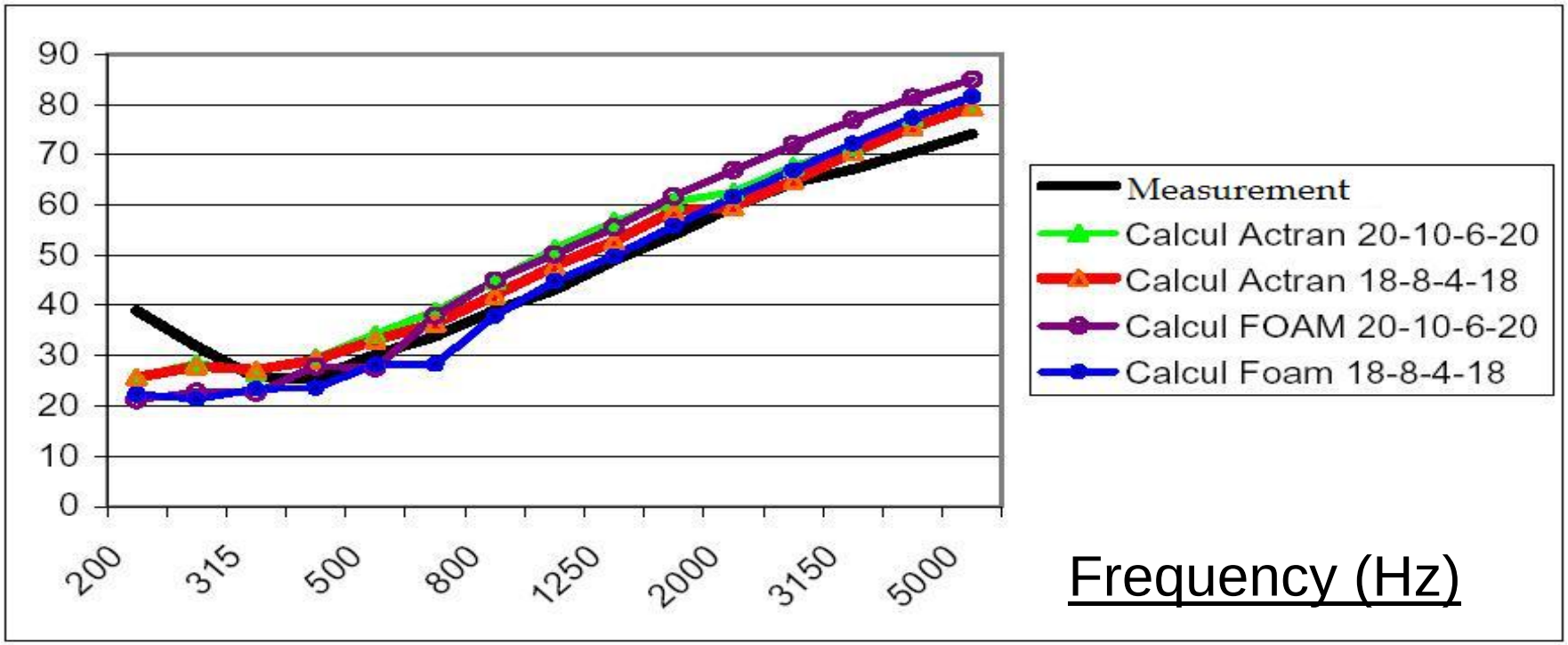
Curved panel

- 8mm steel
- 20mm foam or felt
- Heavy layer (1.75kg/m³)
- Curved radius = 406 or 354 mm



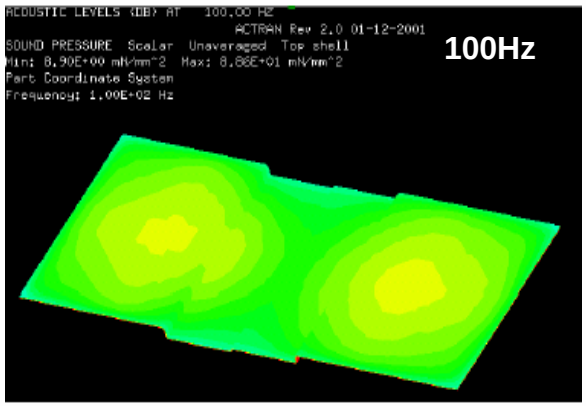
Multiple thickness

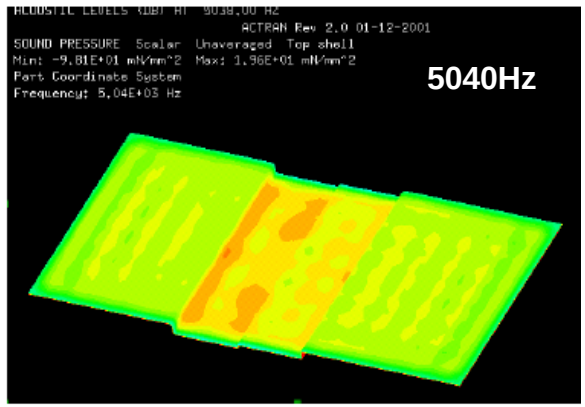
Comparison: measurement, Actran and SEA (Foam)

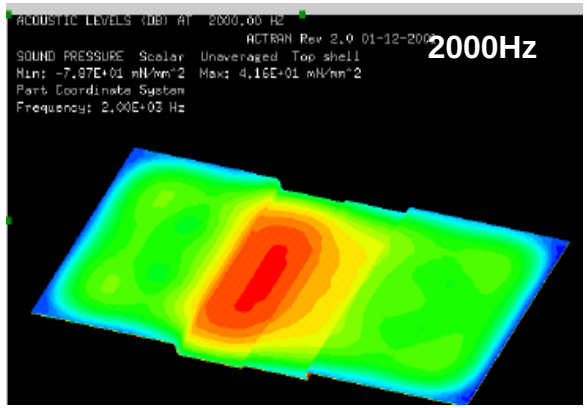


Two simulations are performed. One of them uses a similar structure with 2mm less for each layer. The thickness is an important parameter.

Pressure distribution along the septum





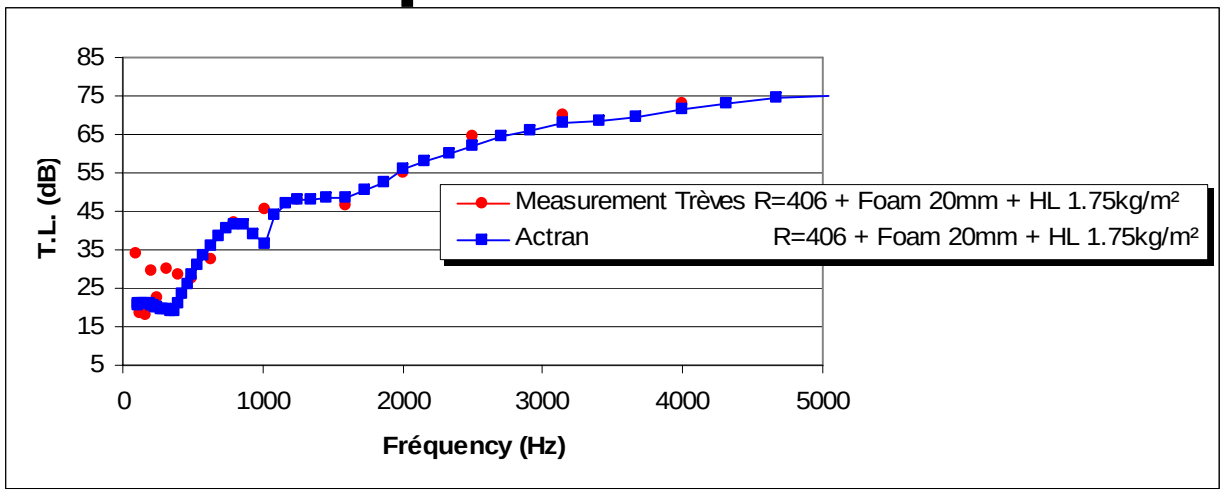


- 100Hz (top left): typical low frequency behavior. Radiation is controlled by the modes (eigenvalues)
- 2kHz (top right): radiation is controlled by the sandwich thicknesses
- 5040Hz (bottom left): the radiation is maximum in the thicknesses discontinuities region

TL box (Trèves)

Test set up to evaluate the transmission loss through curved sandwich panels

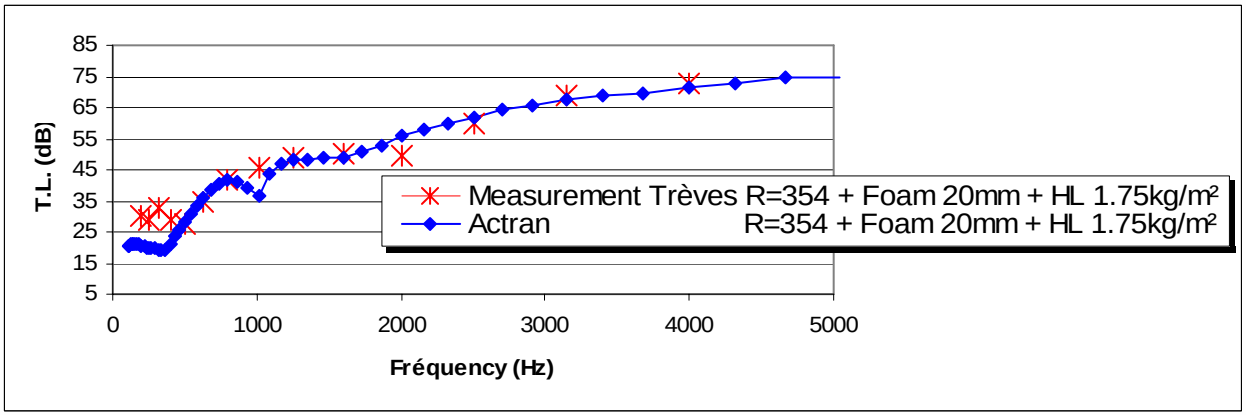
Curved panel



Comparison :

measurement and Actran

R=406 mm

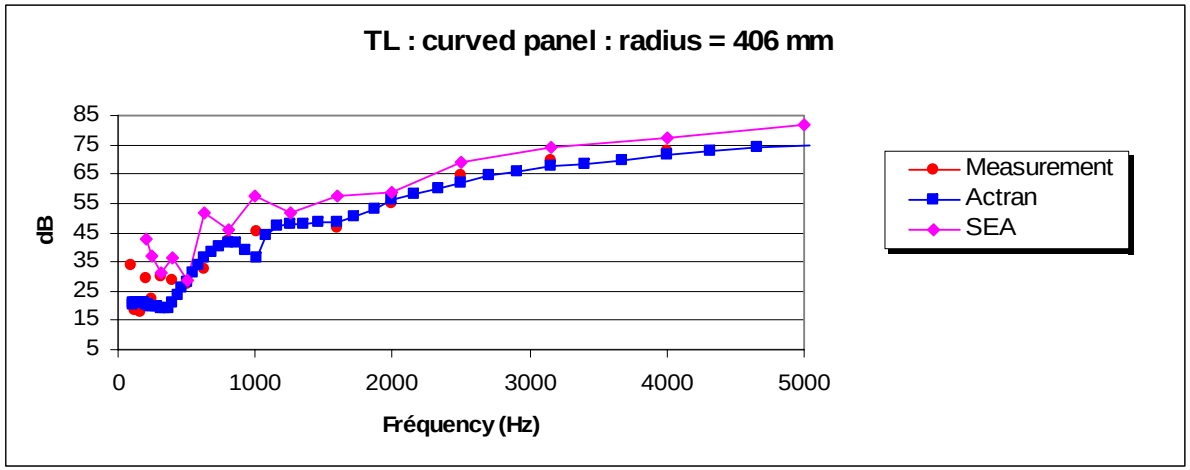


Comparison:

measurement and Actran

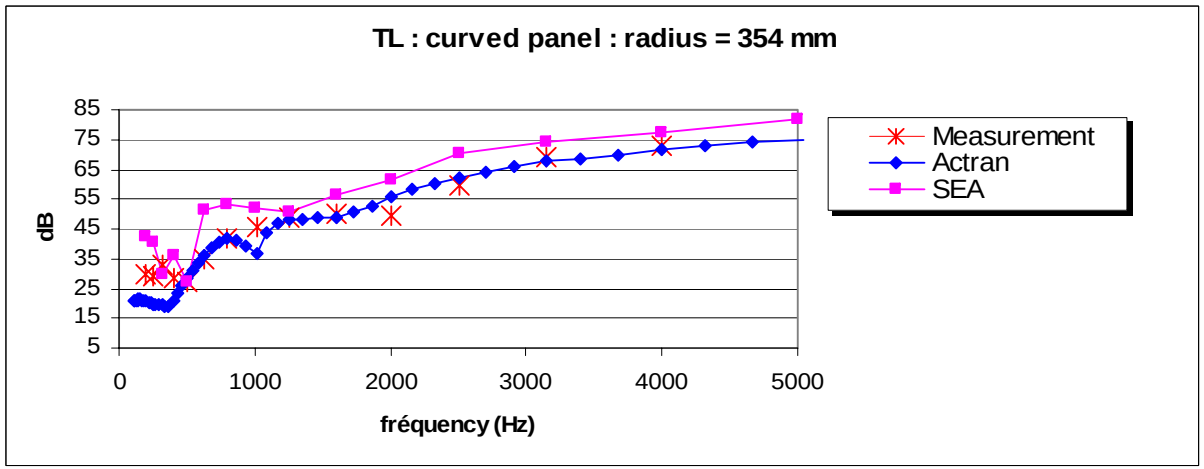
R=354 mm

Curved panel



Comparison: measurement, Actran and SEA

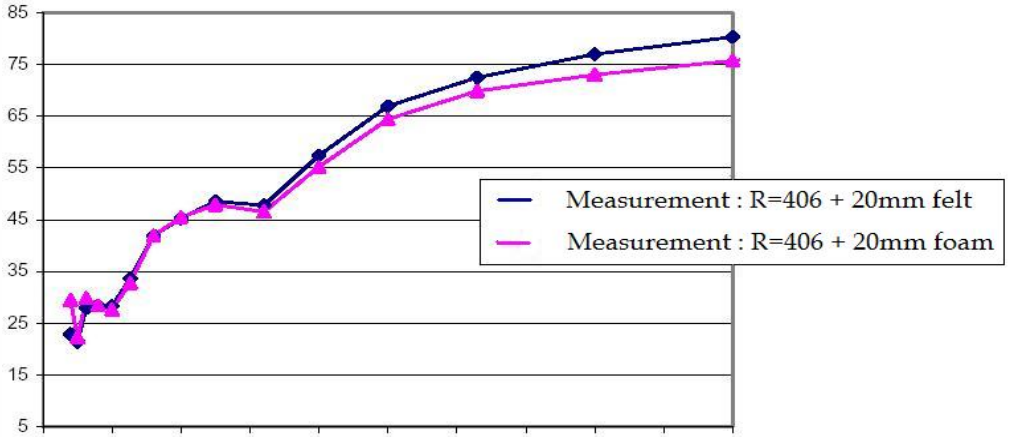
R=406 mm



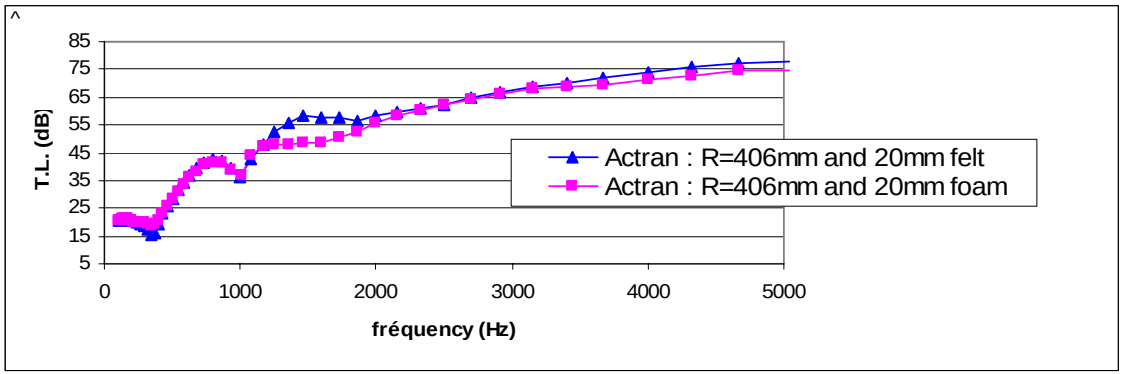
Comparison: measurement and Actran and SEA

R=354 mm

Curved panel



Measurement : felt vs. foam



Actran : felt vs. foam

Conclusions

Multiple thicknesses:

- Good correlation between MSC.Actran, SEA and measurement
- MSC.Actran computes TL index up to 5kHz
- Advantage: pressure distribution can be visualized and is of great help to understand the physics of this type of structure

Curved panels:

- Good correlation between MSC.Actran and measurement
- More accurate than a SEA equivalent flat panel
- MSC.Actran computes TL index up to 5kHz
- Low frequency inaccuracies: no information about BC of experimental set-up
- Advantage: MSC.Actran allows the classification of different treatments in terms of performance