22nd International Congress on Acoustics
Buenos Aires, Argentina
5 – 9 September, 2016

Acoustics for the 21st Century…

REVERSE SEA TO PREDICT FLANKING TRANSMISSION IN TIMBER FRAMED CONSTRUCTIONS

SILENT TIMBER BUILD

Jean-Luc Kouyoumji(a), Gerard Borello(b), Heinz Ferk(c)

(a) FCBA, Bordeaux, jean-luc.kouyoumji@fcba.fr
(b) InterAC, Toulouse, France
(c) Graz University of Technology, Austria

IBERO-AMERICAN FEDERATION of ACOUSTICS
INTERNATIONAL COMMISSION for ACOUSTICS
ARGENTINIAN ACOUSTICIANS ASSOCIATION

Content

- Industrial need at the design stage
- Prediction of flanking transmission
- Measurement
- Use of EN12354 Model
- Use of reverse SEA
- Field transmission loss prediction

Building system : CLT

Building system : CLT

Building system : CLT

Industrial need

- Design the structure, meet all criteria need and all regulations
- Master all design fields
- Compose a structure that don't over estimate acoustic need
- Use as much as possible simple products for assembly

- Create an acoustic design tool
- Agree with control body on the accuracy
- Validate performance at the design stage

Design process

- Building elements
  - Walls, floors, windows, …

Integration 2D

- Construction Build-ups
  - Building elements + Junctions

Integration 3D

- Calculation method is based on SEA, EN12354

Design process

- Need of inputs
  - Measurements only,
  - walls, floors,

  } 2D, R, Ln

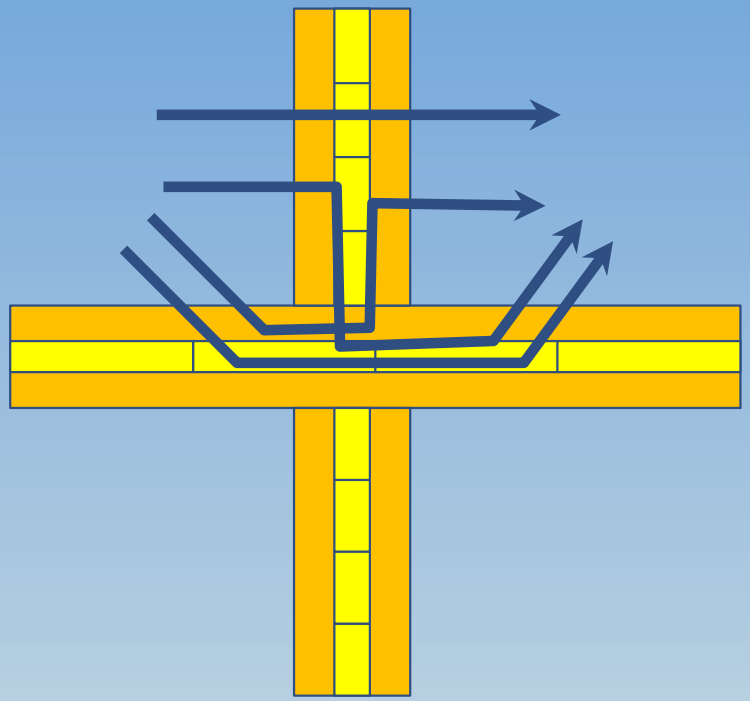
  - Junctions

  } 3D, Dv,ij Kij
  CLF and DLF

- Calculation method is based on SEA, EN12354

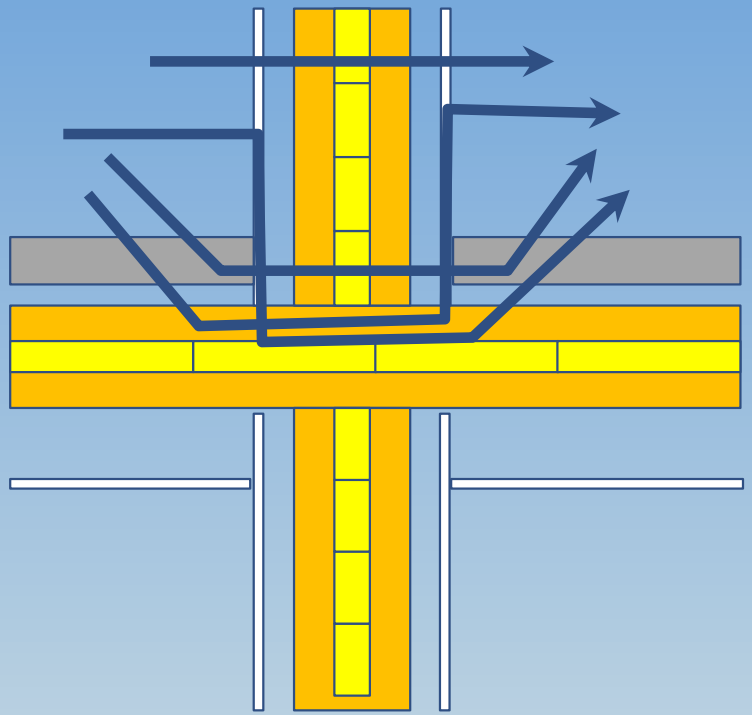
Measurement Strategy

- Measure Dvij or Kij on core structure
  - Using mapping of vibration reduction
- Measure CLF and DLF
  - Using Reverse SEA

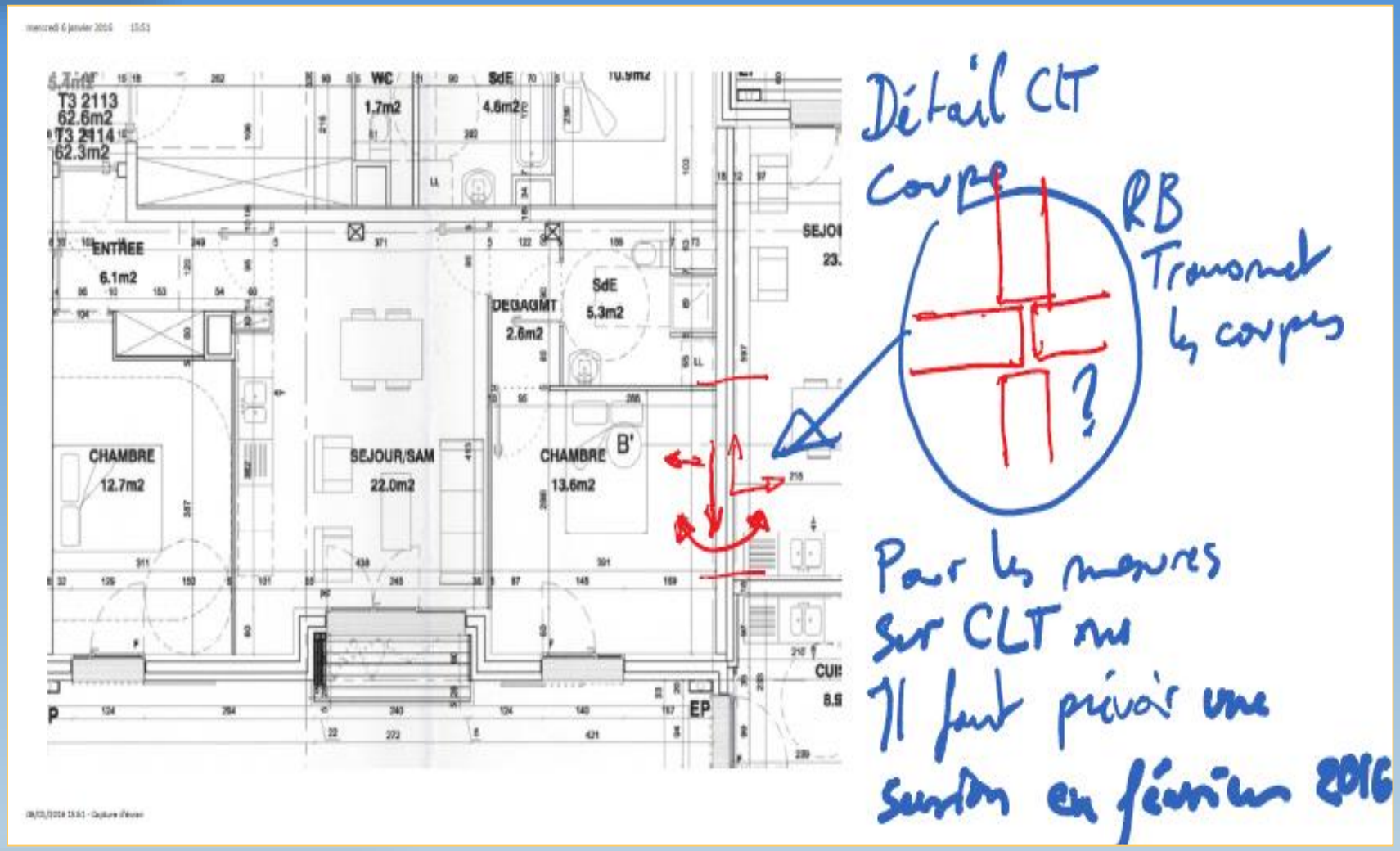


Measurement Strategy

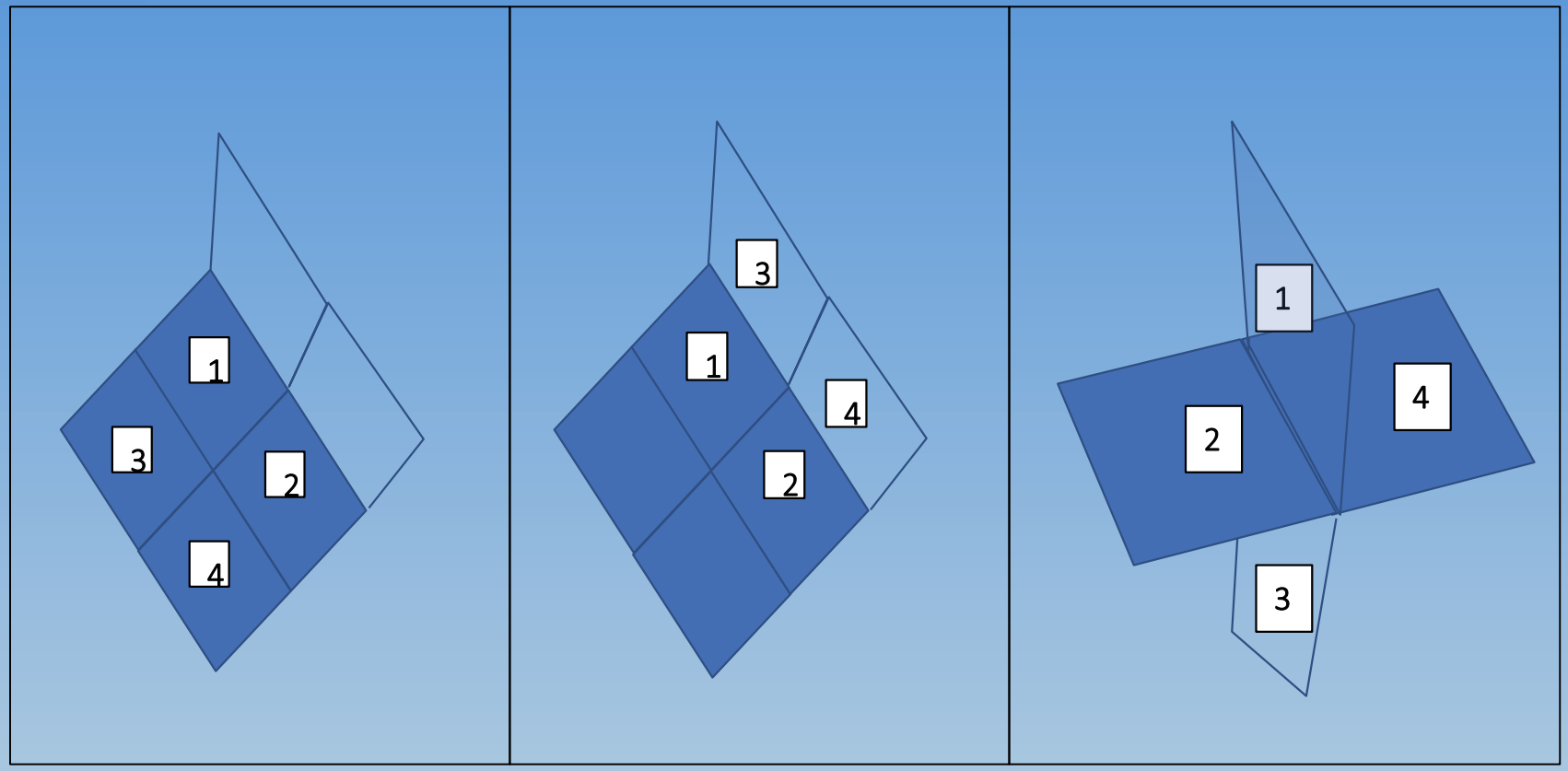
- Measure Dvij or Kij on final structure
  - Using mapping of vibration reduction
- Measure CLF and DLF
  - Using Reverse SEA



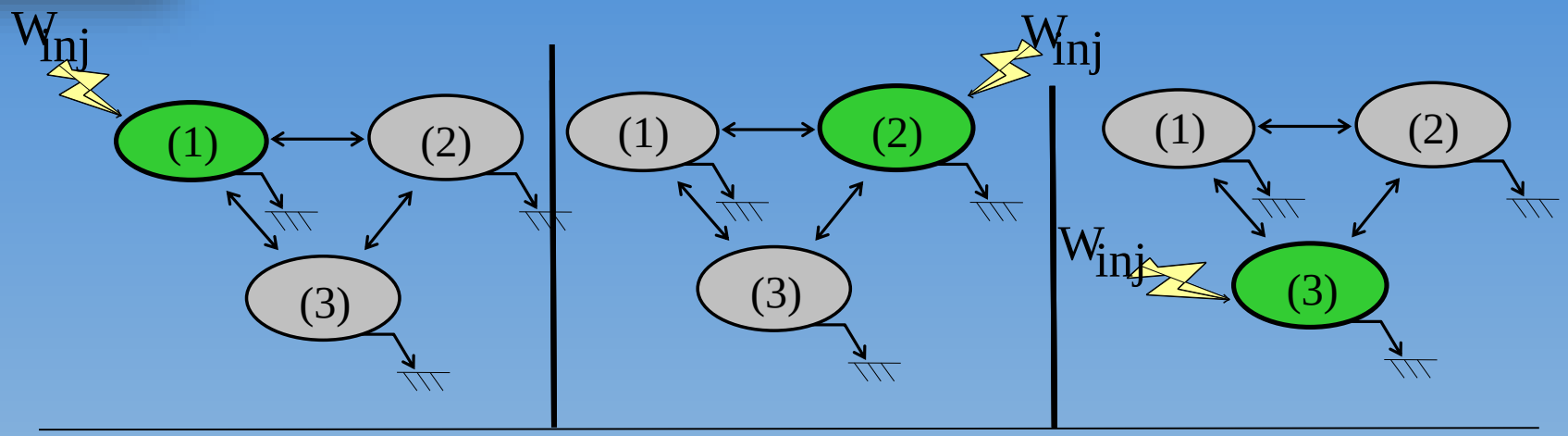
Measurement



Measurement



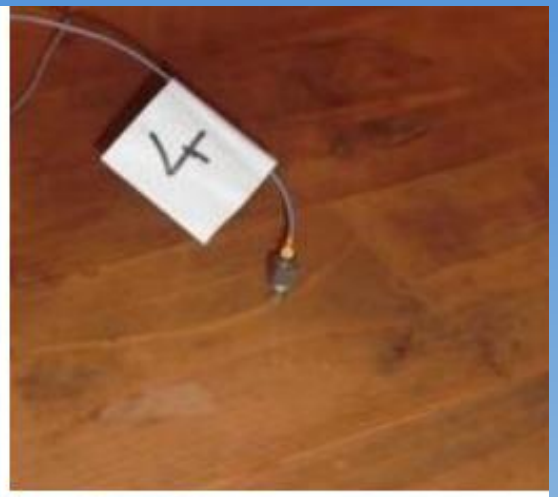
Reverse SEA Methodology

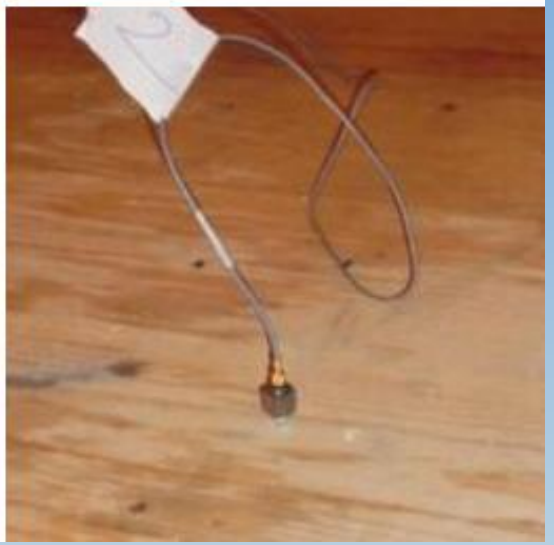


$$\begin{bmatrix} -(\eta_{1d}+\eta_{12}\ldots+\eta_{1n}) & \eta_{21} & \cdot & \cdot & \eta_{n1} \\ \eta_{12} & -(\eta_{2d}+\eta_{21}\ldots+\eta_{2n}) & & & \cdot \\ \cdot & & \cdot & & \cdot \\ \cdot & & & \cdot & \cdot \\ \eta_{1n} & \cdot & \cdot & \cdot & -(\eta_{nd}\ldots+\eta_{nn}) \end{bmatrix} \begin{pmatrix} E_1 \\ E_2 \\ \cdot \\ \cdot \\ E_n \end{pmatrix} = \begin{pmatrix} \dfrac{-W_{inj,1}}{\omega_0} \\ \dfrac{-W_{inj,2}}{\omega_0} \\ \cdot \\ \cdot \\ \dfrac{-W_{inj,n}}{\omega_0} \end{pmatrix}$$

Measurement reduction

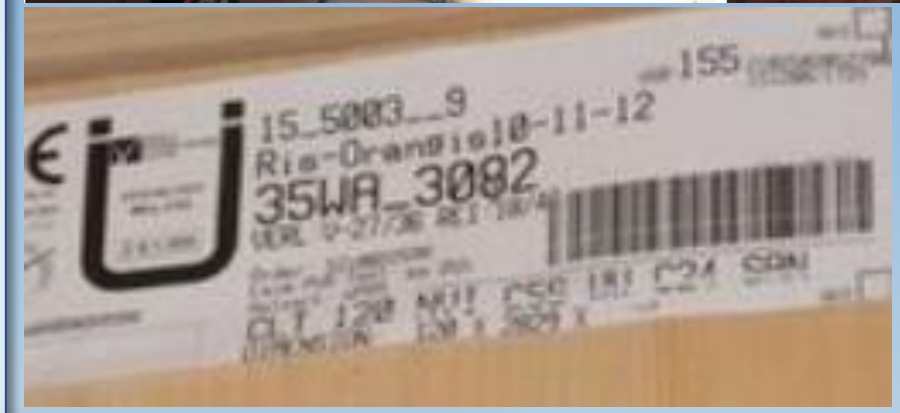
Measurement reduction



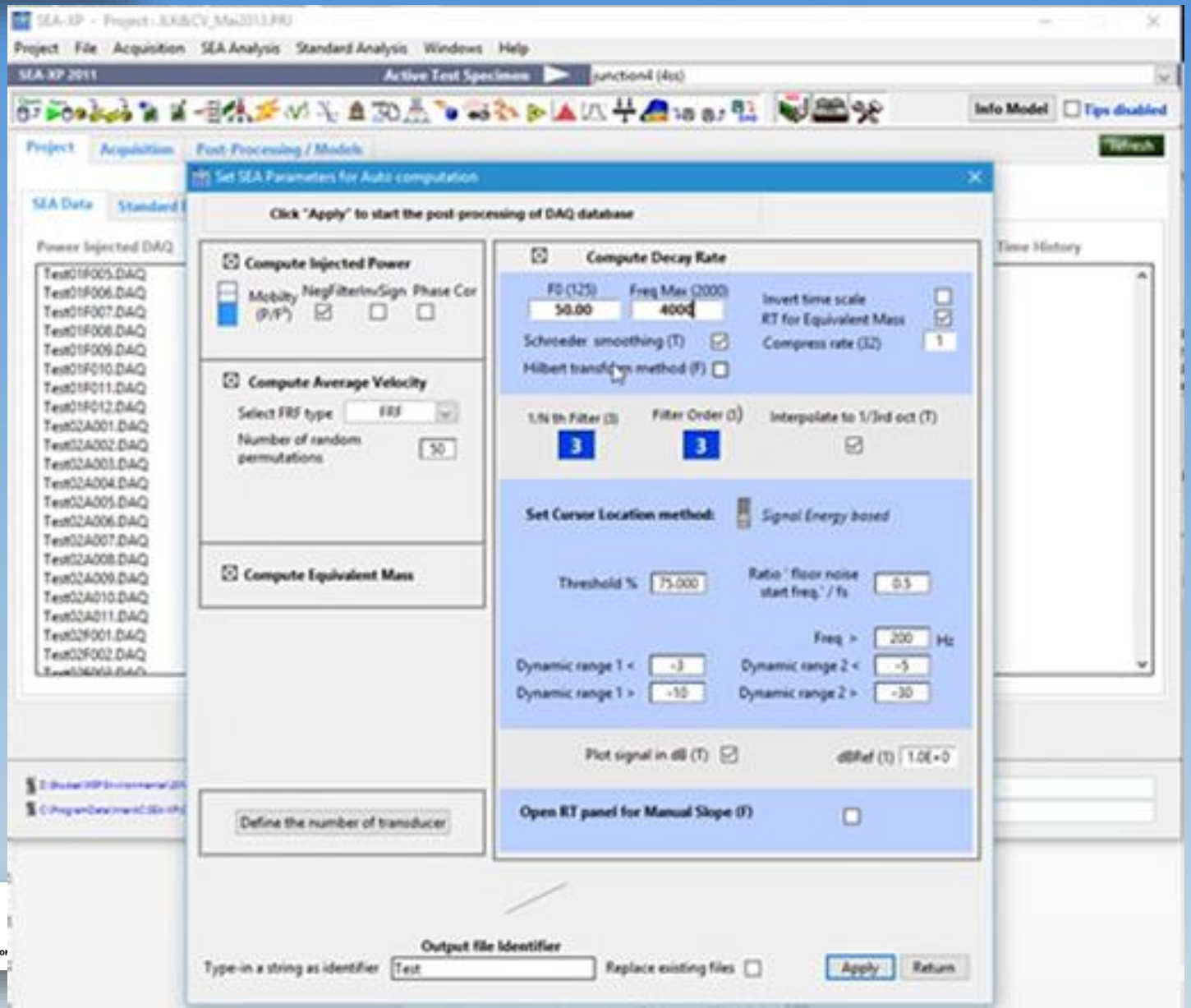


Measurement reduction

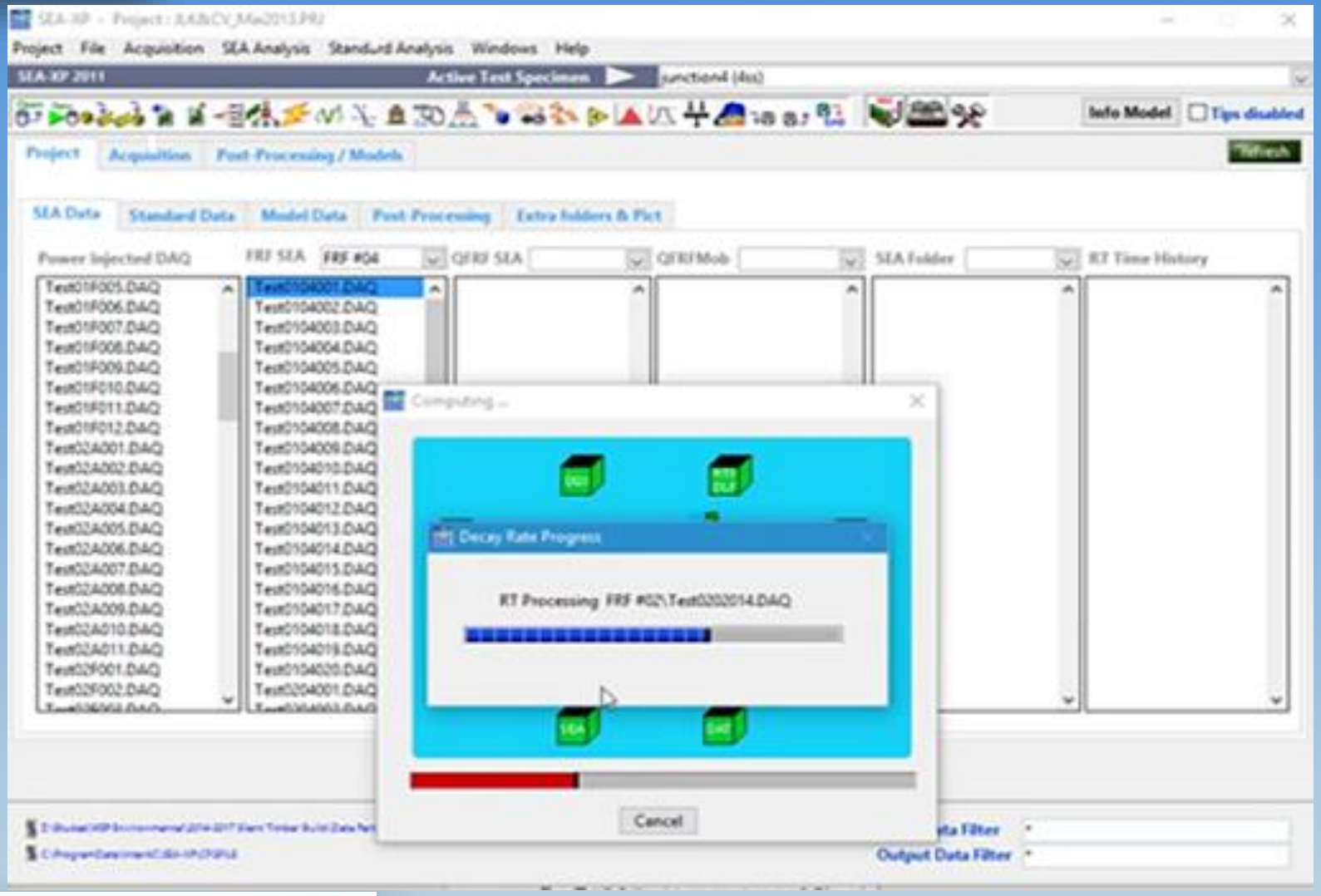
Measurement reduction



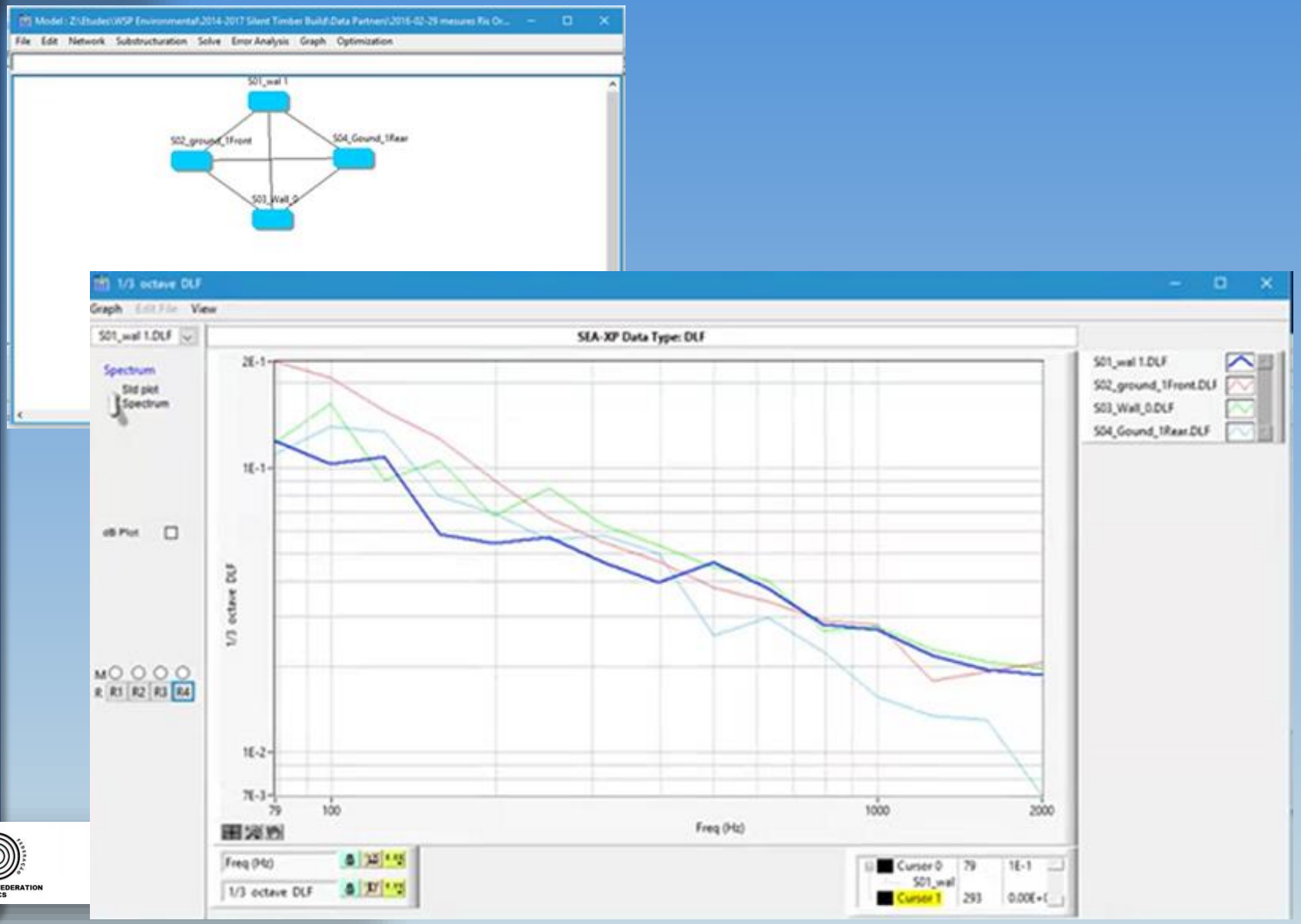
Measurement reduction



Measurement reduction



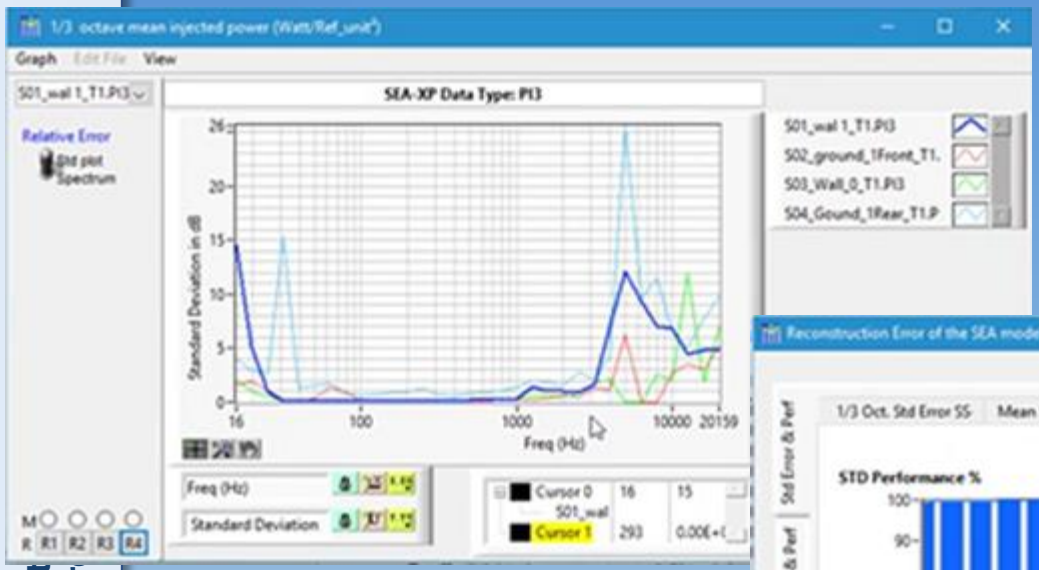
Measurement reduction

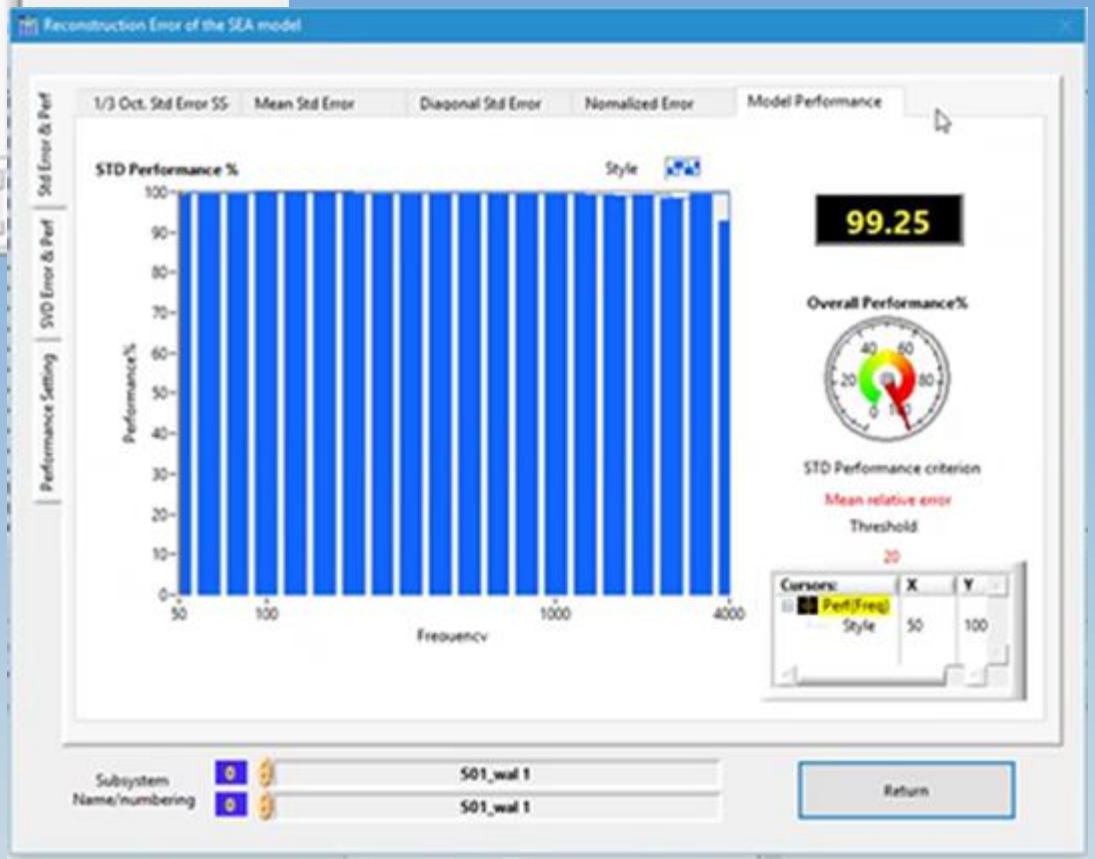


Measurement reduction

22nd International Congress on Acoustics
Buenos Aires, Argentina, 5 – 9 September, 2016

Measurement reduction

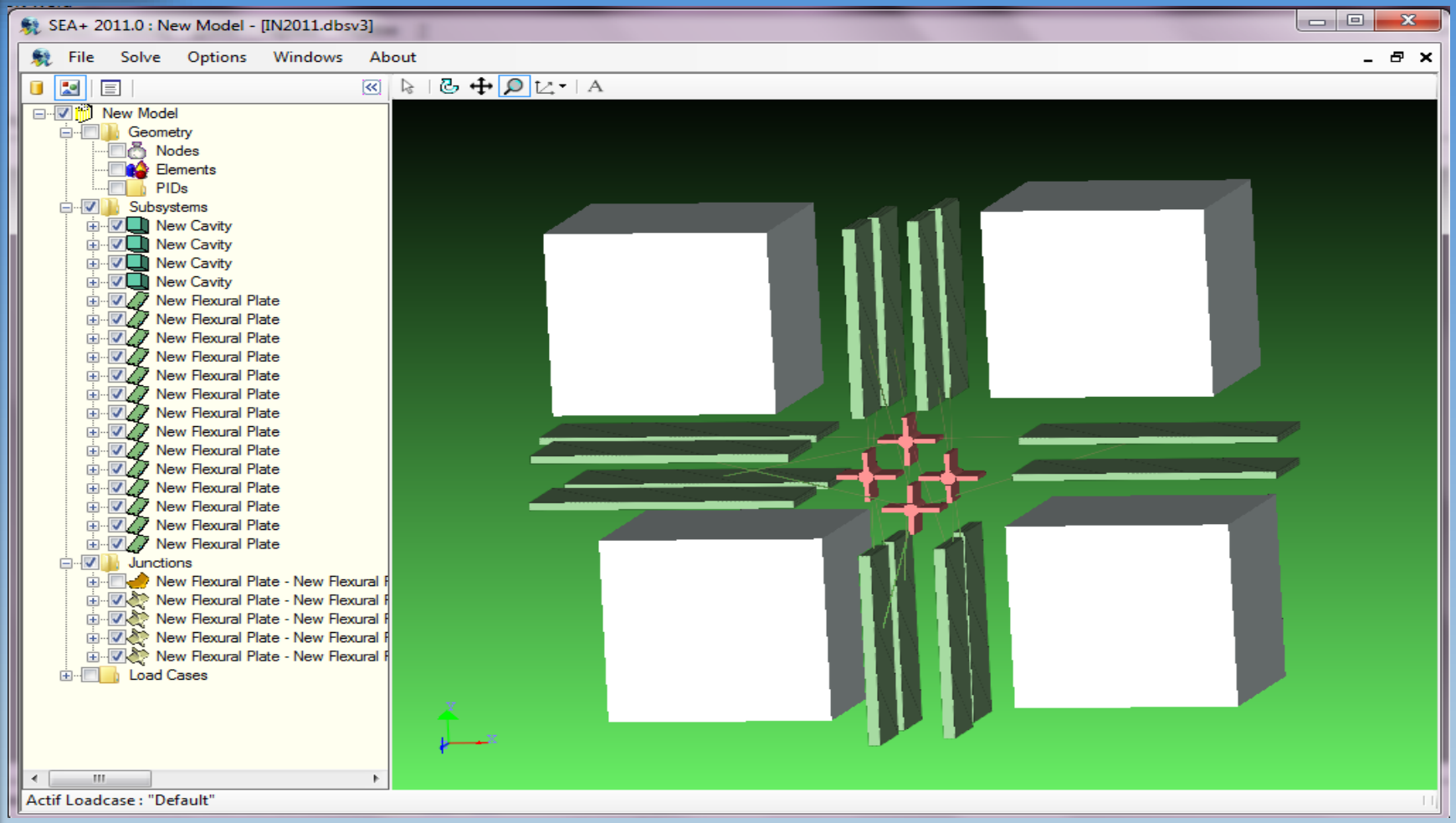




22nd Internat
Buenos Aires, Ar

IBERO-AMERICAN FEDERATION of ACOUSTICS
INTERNATIONAL COMMISSION for ACOUSTICS
ARGENTINIAN ACOUSTICIANS ASSOCIATION

Field transmission loss prediction



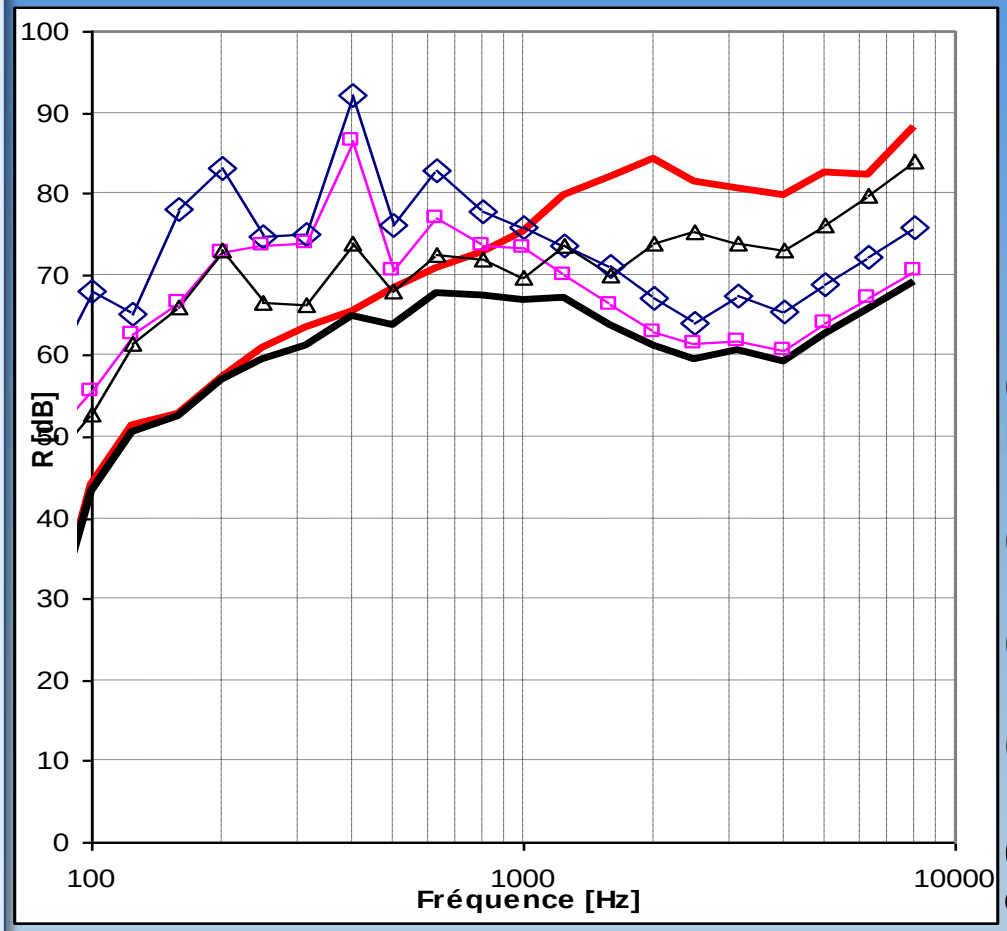
Insulation Calculation

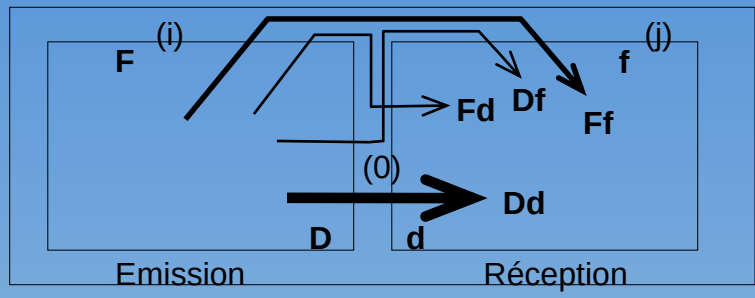
- Combination of all paths

$$R' = -10\log\left[10^{-\frac{R}{10}} + \sum_{ij} 10^{-\frac{R_{ij}}{10}}\right]$$

$$D_{nT} = R' - 10\log\frac{0.16\ V}{T_0 S_s}$$

Insulation Calculation R_{ij} , $D_{n,TA}$





(--), Direct sound transmission loss R_{Dd}, Rw= 70 (-2 ; -8) dB red line

(-□-), flanking sound transmission loss R_{Ff}

(-Δ-), R_{Fd}

(-o-), R_{Df}

(--), D_{nTA} = 64 (-2 ; -4) dB
Global sound transmission direct and flanking

Conclusion

- Flanking transmission prediction with two strategies for measurement is undergoing
- A prediction model will be set using specific junction characteristics
- Using reverse SEA will help in predicting Dv,ij
- With the prediction tool and the growing expertise the designer will be more precise for a more competitive use of products

Thank you for your attention