ACOUSTICS 2012

Vibro-acoustic simulation of a car window

C. Barras

Hutchinson Centre de Recherche, rue Gustave Nourry, BP 31, 45120 Chalette-Sur-Loing, France
christophe.barras@cdr.hutchinson.fr

Teaming up for comfort and safety

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- 3D finite elements model
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Introduction

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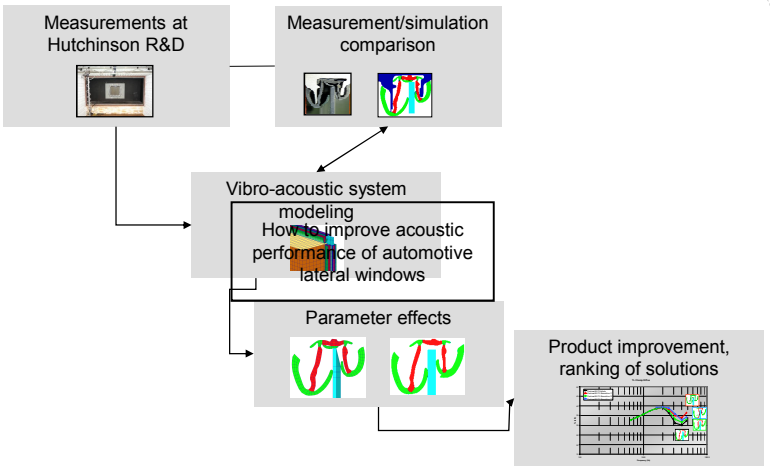

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Acoustic transparency phenomenon

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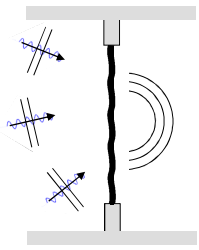
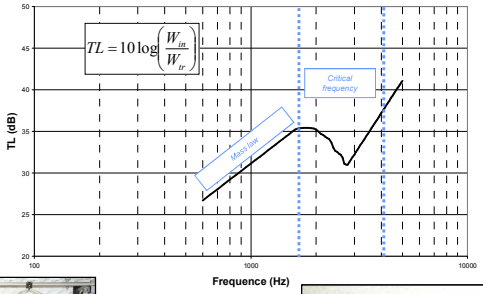
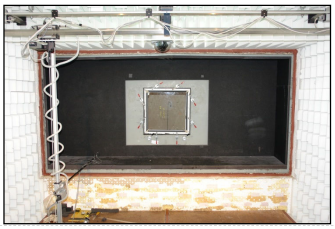
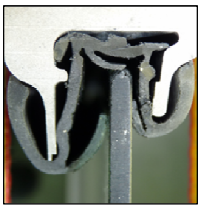


$$TL = 10\log\left(\frac{W_{in}}{W_{tr}}\right)$$







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3D finite element model

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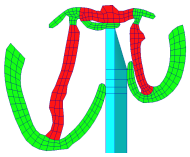
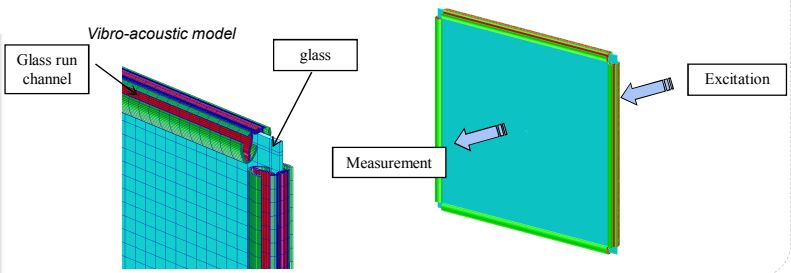
Structural 3D model (dynamic analysis)



- 600×600 mm² glass
- 2-material glass run channel (2.2m long)
- Aluminum frame (rigid)

Vibro-acoustic model



Simulation by MSC/Actran

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Acoustic excitation

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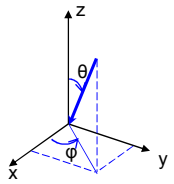
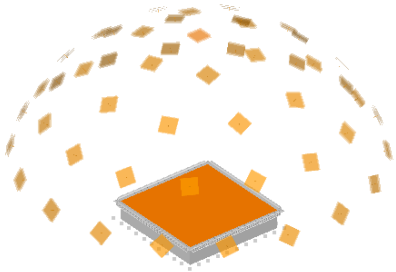
Diffused field :
- same probability for every directions of plane waves

incidence (θ)	number of azimuthal waves (φ)	weighting of wave
0	1	0.2704
17.5	6	0.3095
35	10	0.3311
52.5	15	0.3180
70	18	0.3159

Total waves	50





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Acoustic excitation

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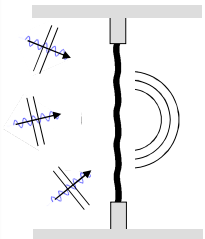
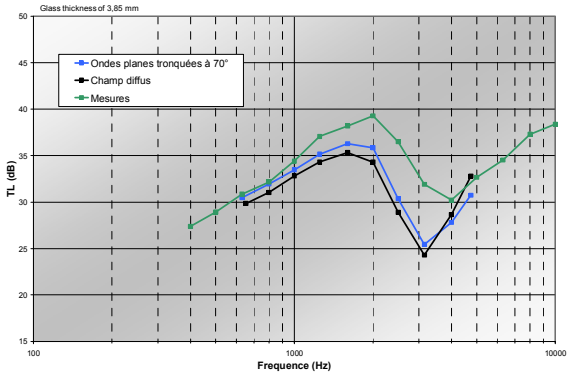
Diffused field :
- same probability for every directions of place waves

Real life measurement :
- truncation of some waves (wall proximity)





→Truncation of waves gives higher TL

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Effect of transmitted power measurement

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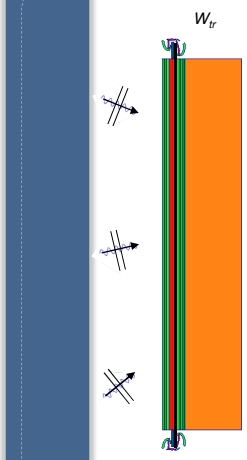

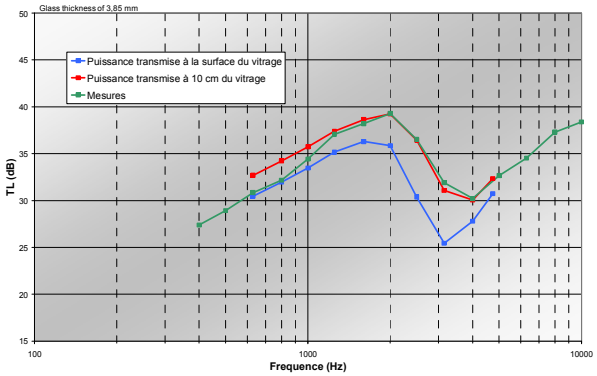

→Measurement of the transmitted acoustic power at 10cm from glass gives higher TL and critical frequency.

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Effect of glass thickness

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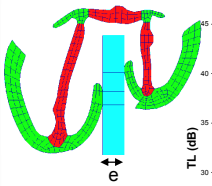

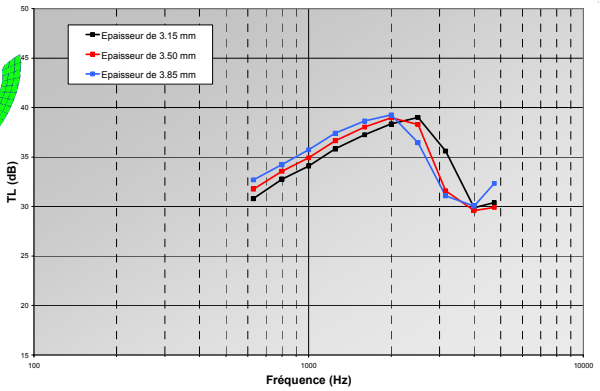

→TL is increased in LF as thickness is increased.
→Critical frequency LF shift with thickness increase.
→Higher TL at critical frequency for large thickness.

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Effect of glass run channel design

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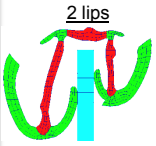
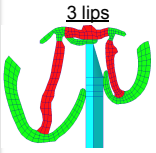
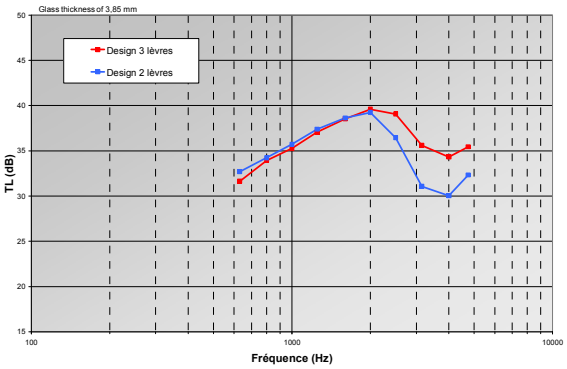
2 lips



3 lips





→Effect at critical frequenncy

→Ranking of glass run channel design

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Product improvement

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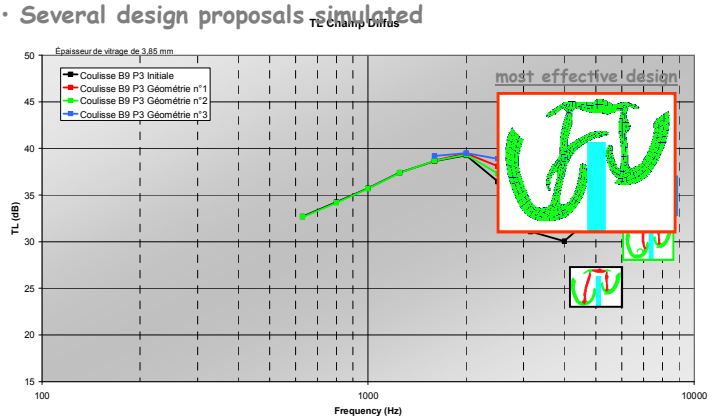
- Several design proposals simulated



→ Ranking of design proposal by simulation

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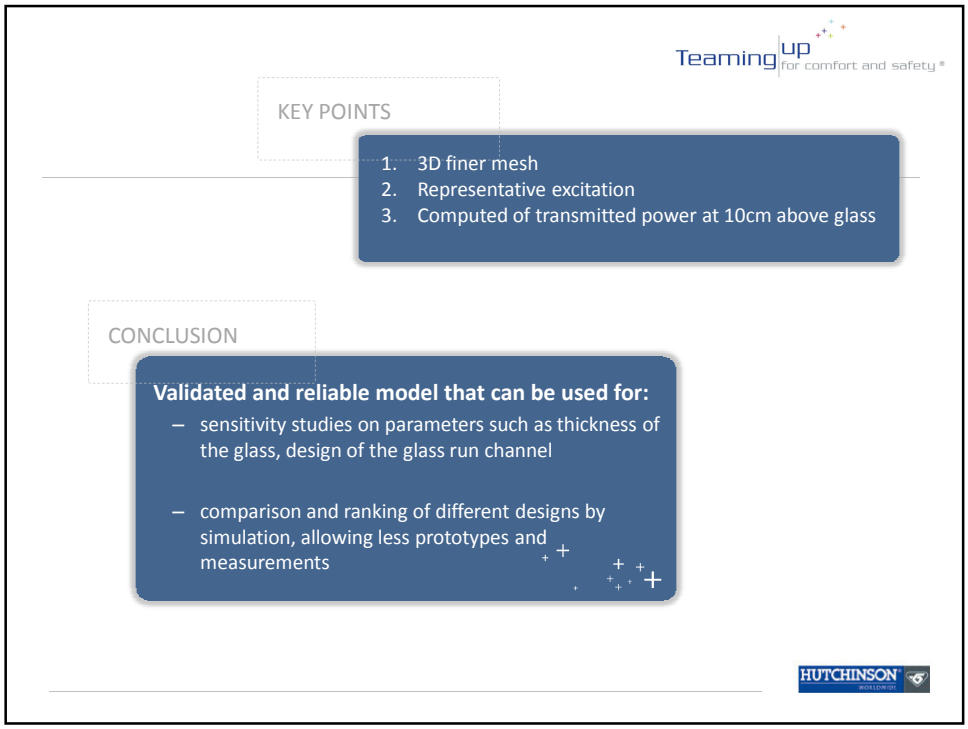
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KEY POINTS
1. 3D finer mesh
2. Representative excitation
3. Computed of transmitted power at 10cm above glass
CONCLUSION
Validated and reliable model that can be used for:
– sensitivity studies on parameters such as thickness of the glass, design of the glass run channel
– comparison and ranking of different designs by simulation, allowing less prototypes and measurements
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