

From Music to Non-Invasive Therapies via COMSOL Multiphysics® Models

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Introduction: Vibration and Music Therapies are non-invasive treatments having effective results although their basics are still disputed. By the application of COMSOL Multiphysics® modules capacities of modeling and analysis some of the nonlinear physical phenomena laying on these applications may be clarified. This study reveals the effects of acoustic stimuli on the human body and the relationship between the surrounding area geometry, acoustic stimuli and human sensitivity.

Results: Obviously, the best places from the Opera Hall are effective only up to frequencies below 3kHz. As for the human staying on stage, if it is the Orchestra Conductor his body would be acoustically impacted at a higher level than the bodies of the audience.

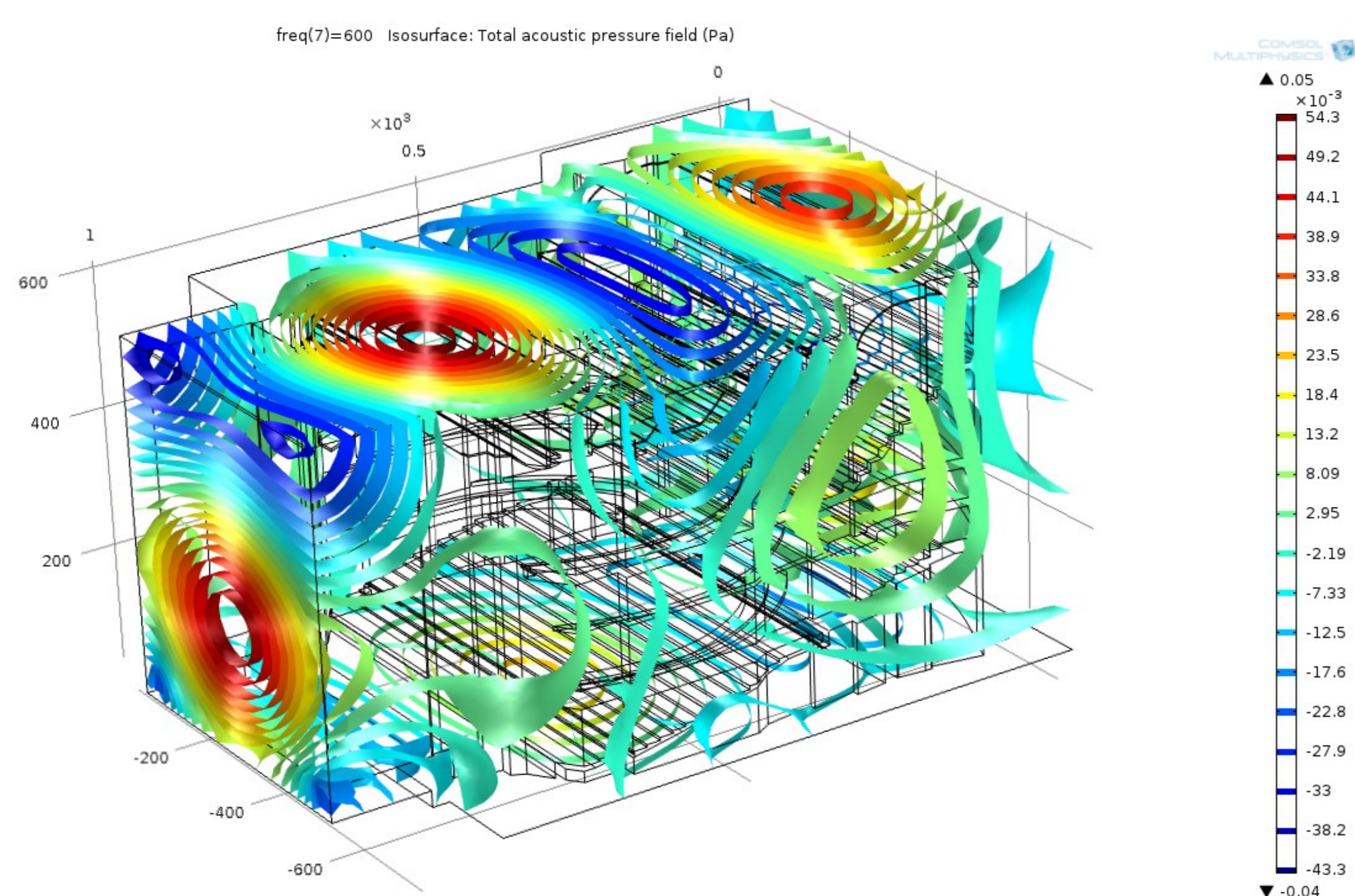


Figure 1. Opera Hall model (f=600Hz)

Computational Methods: For harmonic sound waves in the frequency domain, each of the four designed models has to solve the Helmholtz equation defined in the Pressure Acoustics, Frequency Domain interface of COMSOL Multiphysics® :

$$\nabla \cdot -\frac{1}{\rho_c} (\nabla p_t - q_d) - \frac{k_{eq}^2 p_t}{\rho_c} = Q_m \quad (1)$$

$$k_{ef}^2 = \left(\frac{\omega}{c_c}\right)^2 - k_z^2 \quad (2)$$

All these models have in common the acoustic frequency range with either harmonic or nonlinear variations of the pressure field

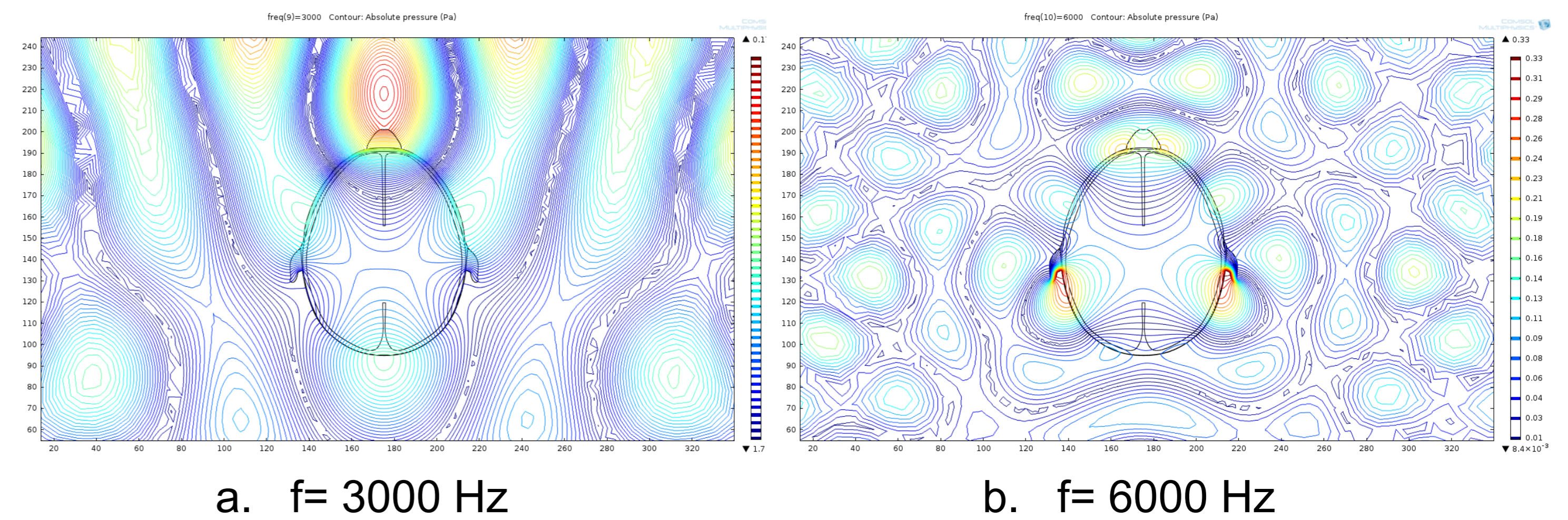


Figure 2. Human Skull model

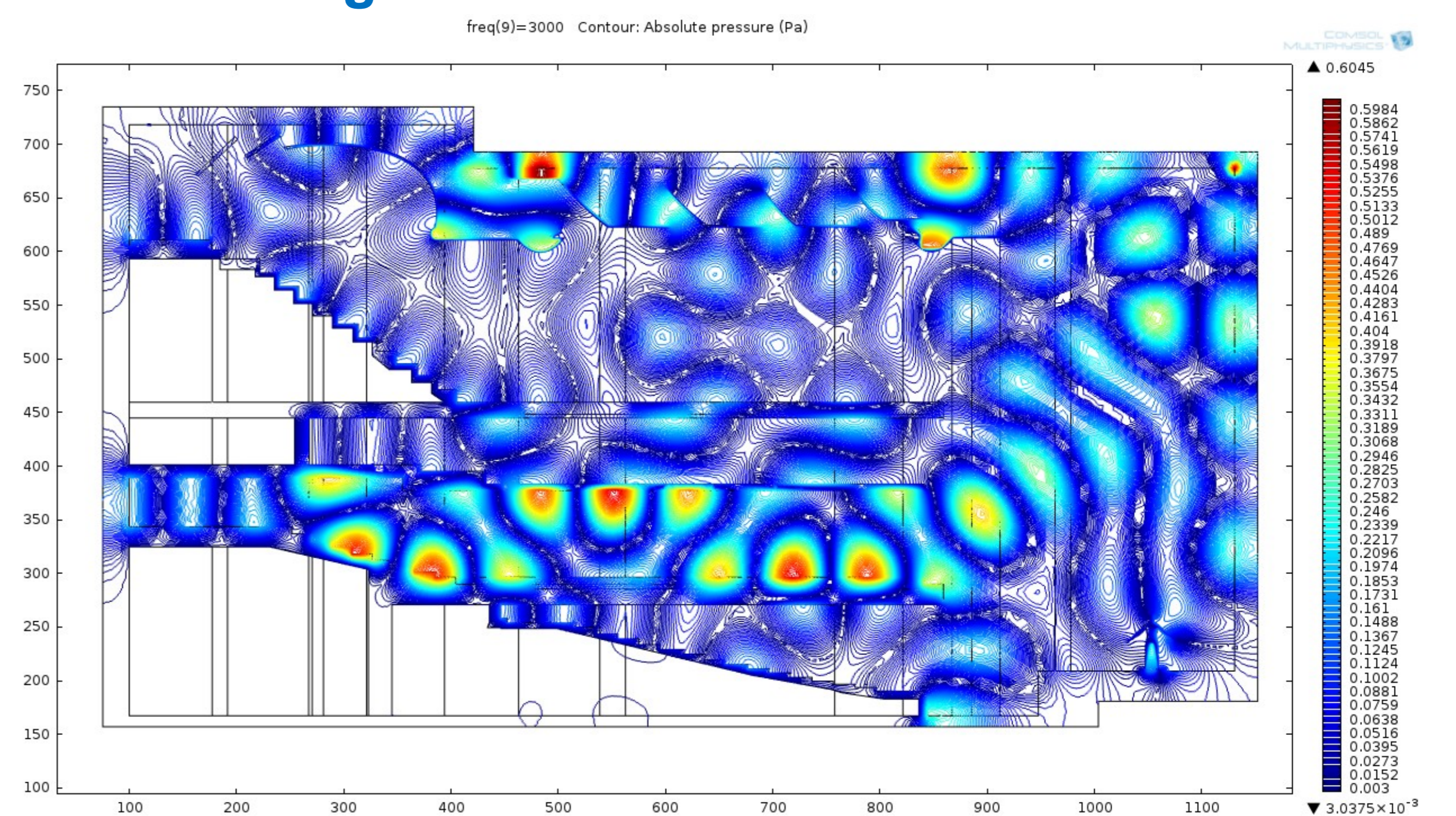


Figure 3. Opera Hall model (f=3000Hz)

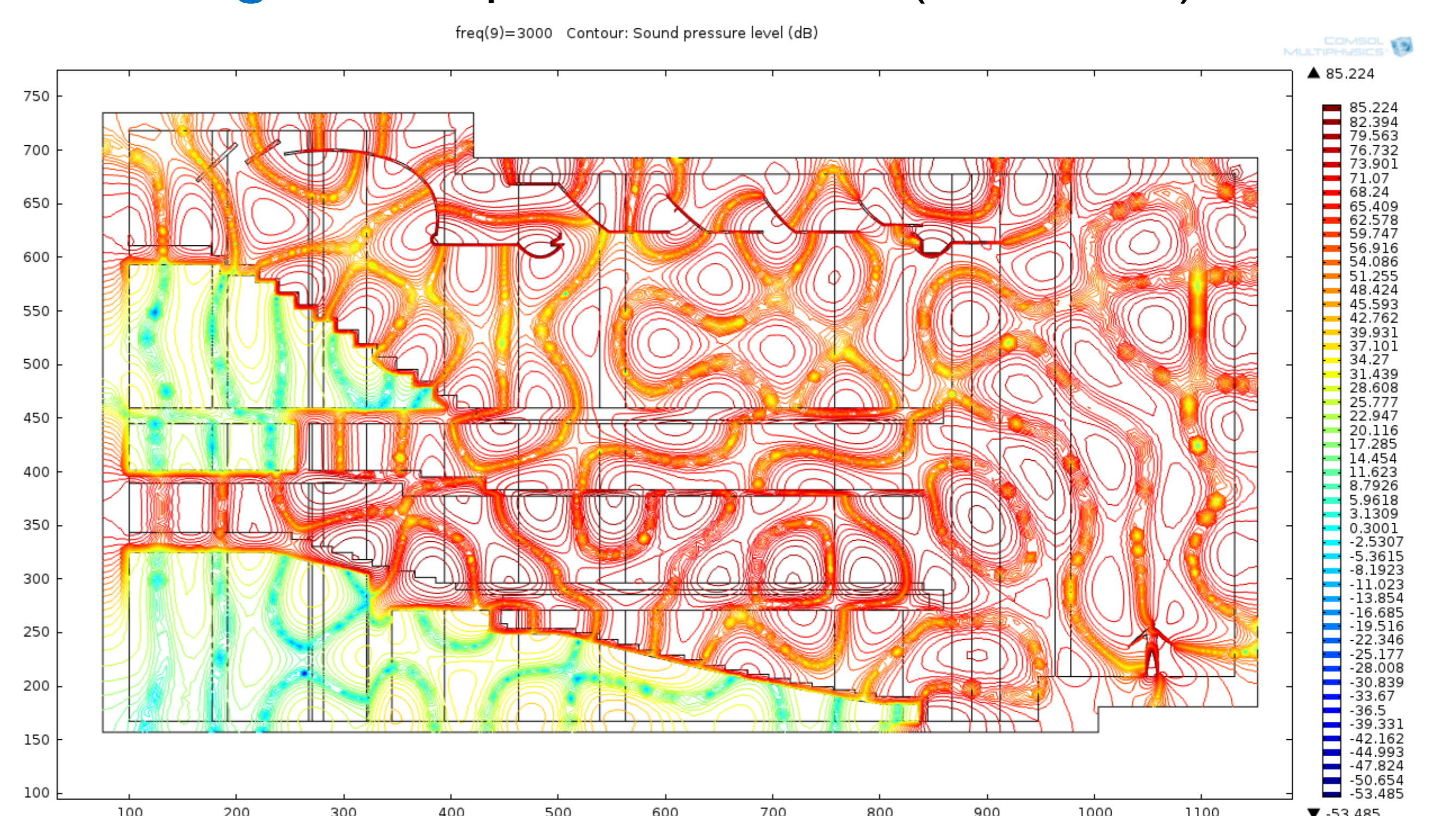


Figure 4. Opera Hall model (f=3000Hz)

Conclusions: Far from gathering only analytic methods and modelling tools COMSOL Multiphysics® clarifies the interdisciplinary models associated to acoustic and vibration therapies giving a real multidisciplinary support to the already acknowledged therapeutic results.