Acoustic Fluid-Structure Interaction Modelling of Gravity Dams in the Frequency Domain

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Introduction: In order to model fluid structure interaction for gravity dams during earthquakes, a frequency response analysis is conducted on a case study, using the Structural Mechanics and Acoustic interfaces.

Computational Methods: The 2D model is shown in Figure 1 with the appropriate boundary conditions. The problem of the infinite length basin is addressed by using both the PML and PWR approaches.

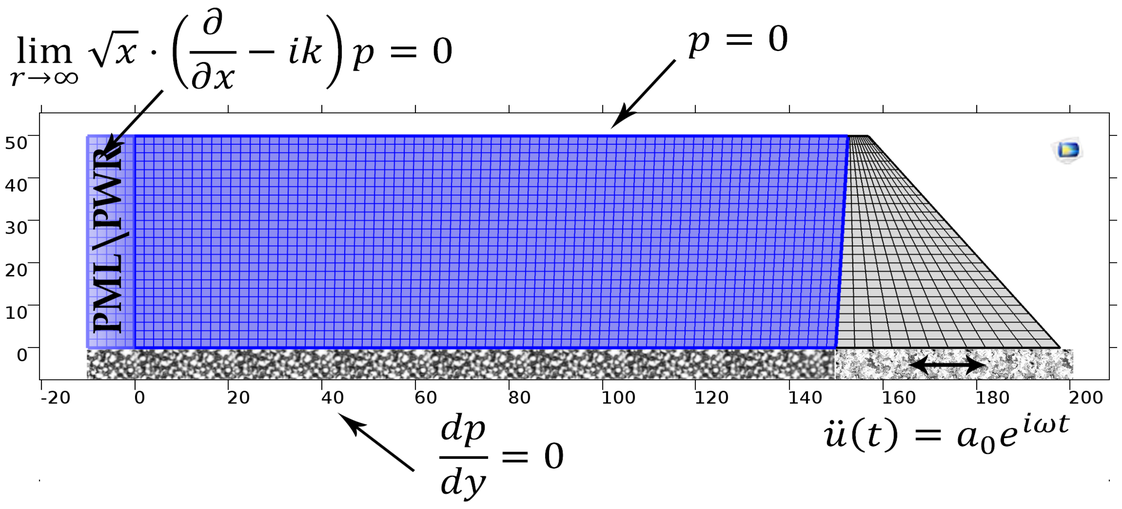

Figure 1. The COMSOL® model.

Results: Frequency response curves obtained for the case of rigid dam are compared to the analytic solution provided by H. M. Westergaard and A. K. Chopra (Figure 2). The PML approach appears to be more suitable than PWR. The deformability of the dam is then introduced and response curves for

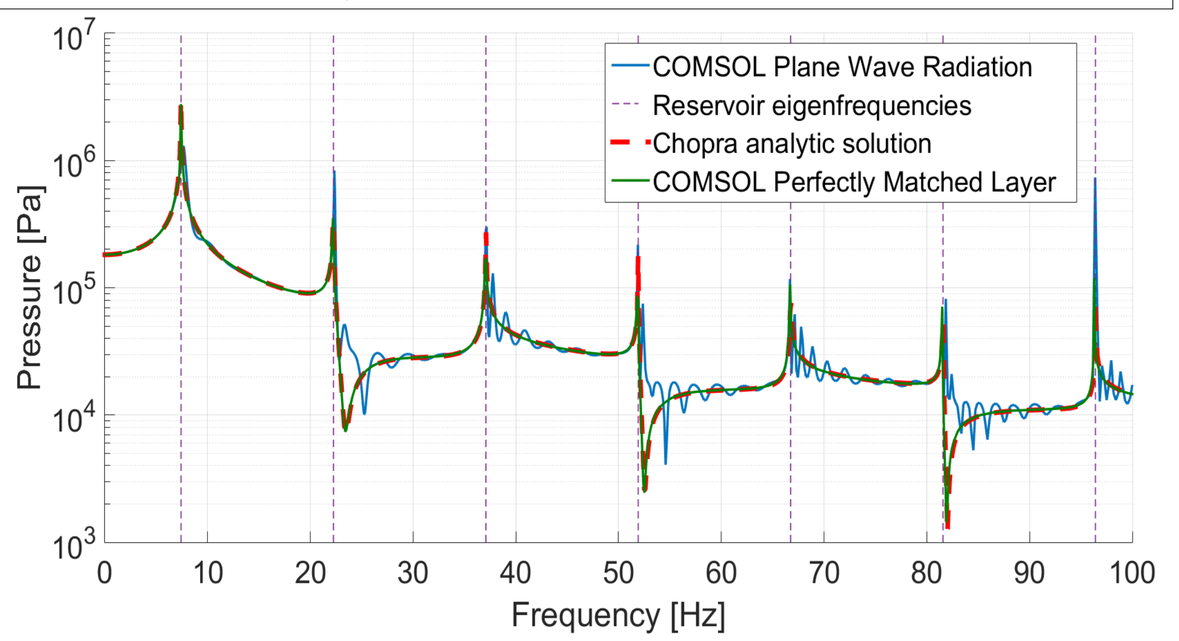

Figure 2. Comparison of PML, PWR and Chopra solution.

different structural damping ξ and sediment reflection coefficients α_r are obtained (Figure 3), showing the different resonance peaks of the model.

Conclusions:The complexity of the fluid structure interaction under earthquake excitation requires a full multiphysics approach which is successfully implemented in COMSOL® Multiphysics.

References:

1. H. M. Westergaard, "Water pressures on dams during earthquakes", Trans. ASCE, vol. 98, pp. 418-433, 1933.
2. A. K. Chopra, "Hydrodynamic pressures on dams during earthquakes", J. Eng. Mech. Div., vol. 93 (EM6), pp. 205-223, 1967.

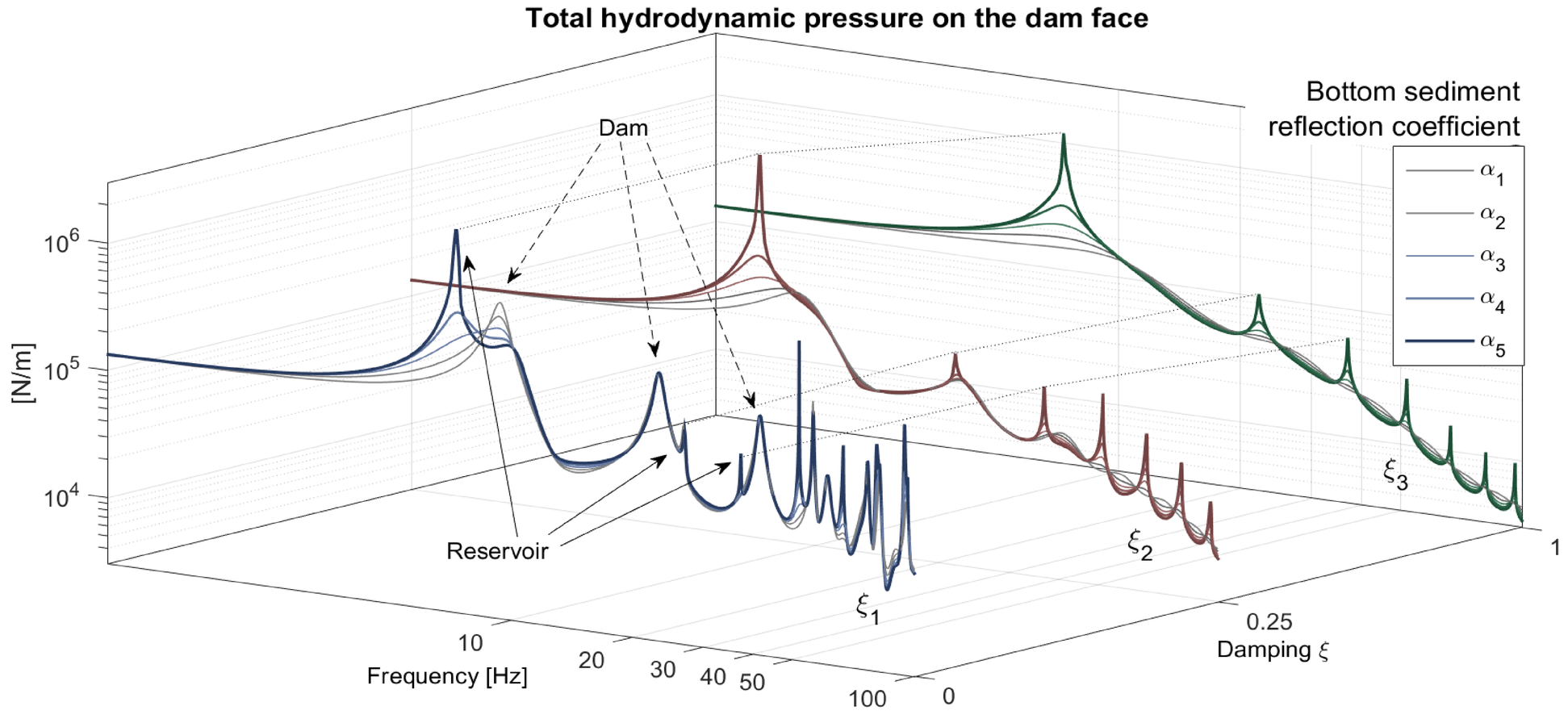

Figure 3. Response curves for the interacting systems for different damping and sediment reflection values.