

Mathematical Modelling in Life Sciences and Technology

Trapped modes in a fluid with three layers topped by a rigid lid

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We consider trapping of linear water waves by a submerged horizontal cylinder in a three-layer fluid topped by a rigid lid. Trapped modes correspond to time harmonic oscillations with finite energy of the fluid surrounding a submerged structure and can be found as eigenfunctions of a certain spectral boundary-value problem. We derive a simple geometric condition relating the cross sections of the submerged parts of the obstacles with the line integrals along the sections of the interfaces pierced by the obstacles that assures the existence of trapped modes: This follows from variational techniques applied to a suitable operator formulation of the problem. Several examples of structures (piercing or not the interfaces between the fluid layers) satisfying the condition and supporting trapped modes are given.

References

- [1] CAL F S, DIAS G A S, PEREIRA B M M, *Trapped modes in a fluid with three layers topped by a rigid lid*, Mathematical Methods in the Applied Sciences, 27(1) , 91-99 (2022).

- [2] CAL F S, DIAS G A S, PEREIRA B M M, VIDEMAN J H, *Trapped modes in a multi-layer fluid*, The Quarterly Journal of Mechanics and Applied Mathematics, 74(1) , 34-54 (2021).
- [3] SAHA S, BORA S N, *Trapped modes in a two-layer fluid of finite depth bounded above by a rigid lid*, Wave Motion, 50(6) , 1050-1060 (2013).