

Pontificia Universidad Católica del Perú
Escuela de Posgrado & Sección Matemáticas



Seminario de Matemática (virtual)

Mathematical Modeling of Waves Generated by Seabed Displacements

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Abstract: In this seminar, we will present our ongoing research on the generation and propagation of surface water waves caused by vertical and horizontal displacements of the ocean floor. One of the key motivations behind this study is the modeling of tsunamis triggered by underwater earthquakes, with the goal of gaining a better understanding of their characteristics and behavior over time. This is a topic of significant social and scientific relevance, drawing interest from fields such as engineering, physics, mathematics, and oceanography. In our work, we adopt the classical hydrodynamic equations as the physical model for the phenomenon. Mathematically, this leads to a Laplace problem with a free and moving boundary, whose evolution — representing the free surface of the ocean — is governed by a nonlinear system of partial differential equations. We have developed a numerical method capable of accurately simulating both the generation and propagation of such waves. A key feature of our approach is the use of a time-dependent conformal mapping, which captures the evolving geometry of the ocean floor and the dynamic wave profile at the free surface. This enables the application of spectral methods for solving the equations with high precision. In the talk, we will compare fully nonlinear results with those obtained from classical linear models (in the case of vertical displacements), and also discuss validation through laboratory experiments (for horizontal displacements). We will explore the main ideas in an accessible manner, covering topics such as partial differential equations, numerical methods, free boundary problems, conformal mapping, and wave dynamics. The talk is intended for a general audience and does not require prior specialized knowledge. This work is the result of a collaborative research effort between UFPR (Brazil), Universidad del Rosario (Colombia), and Pontificia Universidad Católica del Perú (PUCP), and illustrates how advanced mathematical techniques can contribute to the precise modeling of natural phenomena with significant societal impact.

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Hora: 14:00 - 15:00 horas

Transmisión en vivo vía Zoom

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