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Application and Validation of IHFOAM for Modelling Wave Interaction with Rubble-Mound Breakwaters: A Case Study from Bilbao Port (Spain) Supporting Predictive Maintenance Strategies

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ABSTRACT

The Spanish government-funded project, PI-BREAK (Predictive Intelligent System to Optimize BREAKwater Maintenance), aims to address the critical challenge of extending the lifespan of port infrastructure under evolving climate and usage scenarios. While PI-BREAK focuses on adapting outdated breakwaters, this study highlights advancements in the development of a Numerical Wave Tank (NWT) using OpenFOAM (ESI-Group, 2021). This tool is designed to evaluate and optimize the performance of both existing and potential future configurations of the Bilbao Port (Spain). An extensive series of physical experiments was conducted at the IHCantabria experimental facilities, where free surface elevation and wave pressure were measured at multiple points along the breakwater. These measurements provided essential data to validate the numerical model across a range of conditions. This research leverages the IHFOAM suite of tools (Di Paolo et al., 2021a, Di Paolo et al., 2021b), which is tailored for coastal and offshore engineering applications. IHFOAM offers advanced boundary conditions for wave and current generation and absorption, as well as solvers for porous media interactions (Romano et al., 2020). This work presents a preliminary numerical analysis and validation of the PI-BREAK project, showcasing its potential to improve breakwater design and maintenance strategies through cutting-edge numerical and experimental methodologies.

References

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