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ASSESSING THE SUBSEA ACOUSTIC IMPACT OF OFFSHORE POWER STATIONS USING A PARTITION OF UNITY METHOD

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The design of Offshore Power Stations (for wind, wave or tidal energy generation) requires assessing their environmental impact. In particular, it is of the major importance to predict the effect of the generated subsea noise on the sea mammals and fishes.

In this work, we propose to simulate the underwater noise propagation problem by means of the Helmholtz equation. The wave speed in seawater depends on the on salinity, temperature and depth and, hence, we consider a non-uniform wavenumber in our model to improve the fidelity of our approximation. In addition, the acoustic energy attenuation produced by the medium is taken into account through the imaginary part of the wavenumber.

Special attention is focused on the modelization of the boundary conditions. For instance, the reflective properties of the sea bottom and surface are considered, while Perfectly Matched Layers are placed at the artificial boundaries, in order to minimize spurious reflections.

The plane waves PUM (Partition of the Unity Method) method is specially suited for this kind of analysis, where the size of the computational domain is large (from hundreds of meters to kilometers) compared to the characteristic wavelength (from centimeters to meters). In this method, the standard polynomial approximation is replaced by a set of planar waves pasted at each node of the mesh, pointing to different directions.

The implementation of the PUM in this context has been performed using a semi-analytical integration rule, which efficiently integrates the terms of the linear systems of equations to be solved. This allows performing realistic simulations using large element sizes at an affordable computational cost.

In the 3D case, a specific discretization of the planar waves propagation directions is proposed instead of the standard unit cube uniform discretization, leading to an optimization in the resulting number of degrees of freedom. Additionally, we have extended the semi-analytical integration rule to efficiently perform integrals over tetrahedra.

Finally, we will present several examples illustrating the capabilities and the behavior of the proposed method.

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