A numerical model to assess the subsea acoustic impact of offshore power stations

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ABSTRACT

The acoustic pollution due to anthropogenic activities has a direct impact on marine ecosystems. For instance, a high level of exposure produces behavioral changes, masking of sounds of interest, hearing losses and temporary or permanent injuries over the marine fauna. A growing social concern on this issue materialized in several national and international agreements and regulations that establish limits on the generated noise intensity. Therefore, the design of Offshore Power Stations (for wind, wave and tidal energy generation) requires assessing their environmental impact.

We present a numerical model for analyzing the underwater acoustic propagation. Specifically, we solve the 3D Helmholtz equation with non-uniform material parameter (the wave number is characterized by a variable sound speed, depending on the salinity and hence on the spatial location) with different types of boundary conditions and geometrical domains (associated with the actual bathymetry).

The partition of Unity Method (PUM) enriched with plane waves [1] 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 our implementation we have addressed the most relevant numerical issues [2, 3]: fast integration of highly oscillatory functions, the selection of the plane wave direction and the reduction of the condition number of the system matrix.

These contributions allow performing realistic simulations using large element sizes (containing several wavelength per element) at an affordable computational cost. Finally, we present several examples that illustrate the capabilities of the proposed method.

REFERENCES

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