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Bernstein-Bézier finite elements with perfectly matched layer for the prediction of wave agitation in harbors and coastal regions

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ABSTRACT

The aim of this work is to effectively solve wave problems, governed by the linear elliptic mild-slope equation (MSE), on unstructured triangular mesh grids based on the Bernstein-Bézier finite elements. The present model enables to account for non-uniform bathymetry and to accurately describe wave agitation problems. A domain truncation method relying on the perfectly matched layer (PML) concept is performed to address the issues related to open region domains [1]. The proposed PML model uses a non-standard weak form of the truncated MSE to handle the incident wave field weakly and takes into account external bathymetry effects [2]. A low-complexity procedure, exploiting the tensorial property of Bernstein polynomials in conjunction with the sum factorisation method, is applied to set up the local high-order FE matrices. Additionally, static condensation is applied element-wise to reduce the memory requirements. The computer model is extended to predict the wave field in a harbor of arbitrary shape and bathymetry, where the effects of wave reflection, refraction, diffraction, dissipation losses, due to (partially) reflecting boundaries are incorporated. A case study of Mohammedia port is considered to demonstrate the performance of our numerical model.

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