ICCES, 2024, vol.29, no.1
DOI: 10.32604/icces.2024.011054

PROCEEDINGS

Far-Field Underwater Explosion Shock Wave Propagation Simulation Using the Three Dimensional Discontinuous Galerkin Method

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ABSTRACT

The underwater explosion (UNDEX) could cause the fatal damage of naval ships and submarines in the naval battle, and seriously threaten their combat capability [1]. The UNDEX process is very complicated, including the propagation and reflection of the shock wave, formation and collapse of cavitation zone, trainset dynamic structural response and so on [2]. In this paper, we develop the three-dimensional Discontinuous Galerkin method (DGM) model for simulating the propagation of incident shock loading in fluid domain. The pressure cutoff model is employed to deal with the cavitation effect due to the reflection of the shock wave. The model can capture the strong discontinuity of the pressure peak and eliminate numerical oscillations due to the nonlinear cavitation phenomenon. By comparing with several benchmarks, the present model is verified in simulating the shock wave propagation, and exhibits better properties than the acoustic finite element method. And the shock wave loadings calculated by the present model have an obvious tendency to increase abruptly, which is more in line with the loading characteristics of discontinuous shock waves.

KEYWORDS

Underwater explosion; shock wave; cavitation; local discontinuous Galerkin method

Funding Statement: Taishan Scholar of Shandong Province (Young Professional) (No. tsqn202306110).

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

References

1. Wu, W. B., Zhang, A. -M., Liu, Y. L., Wang, S. P. (2019). Local discontinuous Galerkin method for far-field underwater explosion shock wave and cavitation. *Applied Ocean Research, 87,* 102-110.
2. Wu, W. B., Liu, Y. L., Zhang, A. -M., Liu, N. N., Liu, L. T. (2020). Numerical investigation on underwater explosion cavitation characteristics near water wave. *Ocean Engineering, 205,* 107321.