An improved DEM/FEM model for analyzing the ice–structure interaction

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Abstract

This paper proposes a coupled discrete element-finite element method (DEM/FEM), written by an in-house code, to simulate the ice-structure interaction. An efficient algorithm to convert the DEM boundary contact forces to the FEM equivalent nodal forces is developed based on the concept of area coordinate. Meanwhile, the Graphics Processing Unit (GPU)-based parallel scheme is implemented on the DEM calculation and the transmission between the DEM and FEM to improve the computation efficiency. The DEM with bonding-breaking effect between bonded spherical elements is adopted to simulate the breakage of the ice cover and to determine the ice load on the structure. The FEM, using a linear analysis, is applied to calculate the dynamic response of the structure including vibration accelerations and stress distributions. To prove the feasibility of this proposed model, a numerical simulation, the interaction between the sea ice and the offshore wind turbine (OWT), is analyzed and compared with a model test. The numerical results (e.g, ice failure mode, ice load, dynamic response) are discussed in this paper. And a good correlation between experiments and simulations can be found. The results show that the proposed model can provide an effective way to determine the ice failure, ice load and dynamic response in contacting structures subjected from ice particulate materials and can be applied to solve ice-structure interaction problems.

Keywords: **DEM/FEM model, ice-structure interaction, ice load, dynamic response**