Peridynamics and Its Applications in Marine Structures

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Abstract

Prediction of fracture and failure is a challenging research area. There are various methods available in the literature for this purpose including well-known finite element (FE) method. FE method is a powerful technique for deformation and stress analysis of structures. However, it has various disadvantages in predicting failure due to its mathematical structure since it is based on classical continuum mechanics (CCM). CCM has governing equations in the form of partial differential equations. These equations are not valid if the displacement field is discontinuous as a result of crack occurrence. In order to overcome this problem, a new continuum mechanics formulation was introduced and named as Peridynamics [1]. Peridynamics uses integrals equations as opposed to partial different equations of CCM. Moreover, it does not contain any spatial derivatives. Hence, its equations are always valid regardless of discontinuities. In this presentation, the applications of Peridynamics for marine structures will be demonstrated. Particularly, the Peridynamic equations are rederived for simplified structures commonly used in marine structures including beams and plates. Furthermore, underwater shock response of marine composites is investigated. Finally, the peridynamic formulation for contact analysis which can be used for collision and grounding of ship structures will be demonstrated. In order to reduce the computational time, several solution strategies will be explained including parallel programming applications.

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Keywords: Peridynamics; marine structures; numerical modelling; fracture; computational mechanics.

References

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