A NON LOCAL BONDED DISCRETE ELEMENT METHOD FOR ANALYSIS OF ICE FRACTURE AND ICE-SHIP INTERACTION PROBLEMS

Eugenio Oñate[1,2], Miguel Angel Celigueta[1], Salvador Latorre[1], Ferran Arrufat[1], Guillermo Casas[1] and Ignasi de Pouplana[1]

[1]International Center for Numerical Methods in Engineering (CIMNE),
[2]Universitat Politècnica de Catalunya (UPC), Barcelona, Spain
onate@cimne.upc.edu, www.cimne.com

Abstract

We present advances in the development and application of a new nonlocal bonded discrete element method (DEM, www.cimne.com/dempack) [1,2] for analysis of ice fracture and ice-ship interaction problems. The non local bonded DEM is based on defining the constitutive equations relating forces and displacements at the contact interfaces between discrete particles using the stress tensor at the particle center. The stress tensor for each contact interface is computed by averaging the stress field emanating from each of the neighboring particles. The averaged stress tensor is used to determine the failure state of the contact links. The nonlocal bonded DEM can be used with different yield surfaces, thereby extending the applicability of the DEM to a wide range of materials.

In this work the nonlocal bonded DEM is applied to the analysis of fracture of ice samples and to the analysis of the interaction of a cruising vessel and flat ice sheets. Good comparison with experimental results for ice fracture tests and for the expected ice forces on the ship is obtained.

References

[1] Celigueta M.A., Latorre S., Arrufat F., Oñate E., Accurate modelling of the elastic behavior of a continuum with the Discrete Element Method, *Computational Mechanics*, Vol. 60 (6), pp. 997-1010, 2017.

[2] Celigueta M.A., Latorre S., Arrufat F., Oñate E An accurate discrete element method for elastic and non linear analysis of solid materials. Application to concrete fracture tests. *Computational Particle Mechanics* (2019). Submitted