Numerical simulation of shipboard-iceberg collision

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Abstract

The increasing of world demand for energy as well as global warming has enhanced the interest in developing the oil and gas in the Arctic. While sailing in Arctic open water, there is a high risk of encountering icebergs that could cause severe damages to the ship. However, large scale icebergs can always be detected by all kinds of ship electronic instruments like radar. Consequently, there is a great need for studying impact between ships and small scale icebergs or bergy bits.

The shipboard-iceberg collision is simulated using non-linear FEM explicit procedure of LS-DYNA. In order to calculate the impact veritably, Arbitrary Lagrangian-Eulerian(ALE) method has been used to calculate the influence of water accurately. Besides the impact force, the energy absorption curve during the impact is calculated and discussed. We also study the water flowing and liquid level transformation during the impact. In this work, the bilinear elastic-plastic material and the crushable foam have been used to analogize the property of ice. Using the above models, the contact force in the collision and the stress of the shipboard are calculated by considering the shipboard is sailing to an iceberg at different angles and we find that the contact force rises as the angle becomes greater. Ultimately, the discussions are instructive to the engineering practice.

Keywords: shipboard-iceberg collision; non-linear FEM; ALE method; material model.