The Dynamics of Falling Chain

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Abstract

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This thesis is concerned with the behavior of a chain falling in ocean, where the effects of hydrodynamic loads become important. The analysis presented focuses on modeling the chain as a connected set of identical links.

An eigenvalue analysis, based on the linearized two-dimensional model, indicates that the chain system is likely to develop an exponentially growing oscillatory motion, and that an analysis with full non-linearity in both forces and geometry is necessary.

The nonlinear three-dimensional analysis of the chain falling in ocean is treated by using an extension of Kane's equations which include both the relative rotation and relative translation between links. The formulation is

further expanded to account for the hydrodynamic effects (including both the added-mass force and the drag forces) and, the effect of the sea floor.

Several parameters that affect the behavior of the falling chain are identified. The importance of modeling the inter-link rotation and translation is explored by incorporating tangential drag coefficient, number of links, and sliding. Two measures, the mean radius and the falling speed of the top link, are used to study the falling behavior. Both the mean radius and the falling speed are found to be the largest for the top link.

The motion of the top link is sensitive to the tangential drag coefficient and the number of links. With the increase of the value of the drag coefficient, the mean radius increases while the falling speed decreases. A long chain is found to have a larger mean radius of motion than a short chain. Sliding is shown to significantly affect the motion of the chain.

William C. Webster

Professor William C. Webster

Committee Chairman

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