APPLICATION OF HIGDON NON-REFLECTING BOUNDARY CONDITIONS TO SHALLOW WATER MODELS

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In many applications involving wave propagation, problem domains are often very large or unbounded. A common numerical method used to solve such problems is to truncate the domain via artificial boundaries to form a finite computational domain. To accomplish this, Non-Reflecting Boundary Conditions (NRBCs) which minimize spurious wave reflections are imposed. The quality of the solution strongly depends on the properties of both the NRBC and the wave behavior.

This dissertation explores the use of Higdon NRBCs to solve shallow water equations (SWEs) in a dispersive environment. A linearized SWE model is developed that includes stratification and advection effects. Initially, a single NRBC is used to truncate a semi-infinite channel. Later, four NRBCs are used to restrict an infinite plane. In both cases, finite rectangular domains are formed. A scheme developed by Neta and Givoli is used to rapidly discretize high-order Higdon NRBCs. Finite difference methods are used in all numerical schemes, which are solved explicitly when possible. Results will show that Higdon NRBCs can be used effectively to restrict large rectangular domains when solving SWEs that include the before mentioned effects.

KEYWORDS: Waves, High-order, Artificial Boundary, Non-Reflecting Boundary Condition, Higdon, Finite Difference, Shallow Water Equation, Stratification

ANALYTIC EXPRESSION OF THE BUCKLING LOADS FOR STIFFENED PLATES WITH BULB-FLAT FLANGES

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The subject of this research is the buckling behavior of a simply supported rectangular plate, with a bulb-flat stiffener attached to one side of the plate. The plate structure is subjected to axial compression that increases to the buckling load. The stiffener cross-section has a thin web and a bulb-flat flange that extends to one side of the web. Results of the investigation include planar property formulas for the asymmetric flange geometry, an analytic expression for the Saint Venant torsional constant of the flange cross-section, and an analytic expression for the buckling load corresponding to a tripping mode of the structure. The torsional constant for the bulb-flat stiffener is 15% - 23% higher than understood previously. The analytic expression for the buckling load of the bulb-flat stiffened plates considered in this investigation yields values that are 2% - 6% higher than finite element results. It is also shown that the buckling load of a plate with a bulb-flat stiffener is 3% - 4% less than that of a plate with a T-flange stiffener with the same cross-sectional area. At the onset of stiffener tripping, the torsionally superior bulb-flat tends to bend laterally, while the flexurally superior T-flange tends to twist.

KEYWORDS: Stiffened Plates, Bulb-flat, Torsion, Saint Venant, Buckling Load