HIGH-ORDER ABSORBING BOUNDARIES FOR TIME-DEPENDENT PROBLEMS

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For wave problems in infinite domains, the method of Absorbing Boundary Conditions (ABCs) is based on truncating the domain via an artificial boundary $\mathcal{B}$, thus forming a finite computational domain Ω bounded by $\mathcal{B}$. A special boundary condition, called ABC, is imposed on $\mathcal{B}$ in order to complete the statement of the problem (i.e., make the solution unique) and, most importantly, to ensure that no (or little) spurious wave reflection occurs from $\mathcal{B}$. Then the problem is solved numerically in Ω. Naturally, the quality of the numerical solution strongly depends on the properties of the ABC employed. In the last two decades, much research has been done to develop ABCs that after discretization lead to a scheme which is stable, accurate, efficient and easy to implement.

Recently, *high-order* local ABCs have been introduced. Sequences of increasing-order ABCs have been available before (e.g., the Bayliss-Turkel conditions constitute such a sequence), but they had been regarded as impractical beyond 2nd or 3rd order from the implementation point of view. Only since the mid 90's practical high-order ABC schemes have been devised. Most of these schemes are developed from a sequence of ABCs which, in their original form, involve high-order derivatives in both space and time. A key feature in each scheme is the elimination of all high-order derivatives beyond second order. This allows easy implementation of the ABC by standard Finite Difference (FD) or Finite Element (FE) discretization methods. Some, but not all, of these high-order ABCs are exact in a certain sense which will be discussed.

A new high-order local ABC scheme is proposed here for the Klein-Gordon wave equation and for the shallow water equations, based on the Higdon operators. Wave dispersion and stratification can be included in the model without difficulty. The ABC is easily implemented using either FE or FD discretizations. The ABC is of an *arbitrarily high order J*. The scheme is coded once and for all for any order J; J is simply an input parameter given by the user. The performance of the scheme will be demonstrated via numerical examples.