

The Artificial Boundary Method

—Numerical Solutions of Partial Differential Equations on Unbounded Domains

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Abstract

The aim of this talk is to introduce the artificial boundary method, which has been established as a powerful and effective technique to obtain the numerical solutions of partial differential equations on unbounded domains in recent twenty five years.

Many problems arising in science and engineering lead to solving the boundary value problem of partial differential equations on unbounded domains, such as the stress analysis of a dam with infinite foundation, fluid flow around the obstacle and fluid flow in an infinite channel. The great new difficulty in finding the numerical solutions of these problems is the unboundedness of the physical domain. Therefore finite element method and finite difference method can not be used for these problems in a straight forward manner. The artificial boundary method is to introduce an artificial boundary to reduce these problems on a bounded computational domain and set up a suitable boundary condition at the artificial boundary. Then solve the reduced problem. Therefore how to design the suitable boundary conditions with high accuracy on a given artificial boundary for the problems on unbounded domains, or how to solve partial differential equations on unbounded domains numerically, has attracted the attention of many engineers and mathematicians. In the last more than twenty years, large number of mathematicians and engineers are involved in this subject, who have studied various problems from science and engineering by different approaches. We will introduce the new development in this research direction.