数学与系统科学研究院 计算数学所学术报告

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报告题目:

Parallel numerical solution of assimilation data problem for tidal flows by SMP-nodes clusters

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Abstract:

This work is devoted to numerical modeling of surface wave in large water area taking into account the sphericity of the Earth and Coriolis acceleration. The boundary problem for shallow water equations is set in a domain with two kinds of part of the boundary: "solid" for the coastal contour and "liquid" for the sea boundary. We consider the inverse problem where the boundary conditions contain an unknown function. We can find this function together with velocities and sea surface. The additional condition connected with obtained data is used to close the problem. To solve inverse problem the methodology for assimilation data problem by Prof. V.I. Agoshkov is used. This approach is based on optimal control methods and adjoint equations theory. The discrete problem is obtained on the special compatible triangulation. The Bubnov-Galerkin method is used for the approximation with respect to space. Linear functions on triangular finite elements are used as trial and test functions. A priori stable estimations are derived for discrete analogue. The second order of approximation in internal nodes was shown. The numerical experiments were carrying out for the test problem with known exact solutions and for Sea of Okhotsk and World Ocean. Using FEM we obtain a system of linear algebraic equations which has a great dimension for real computational domain. Hence the high performance computation is necessary to solve it. For construct parallel algorithm we use an explicit potential of data parallelism for our discrete problem. In this work efficiency is compared for some parallel realizations of an algorithm for the numerical solution of the boundary-value problem which were performed with the help of the MPI library for C language. Two approaches are considered to the decomposition of a computational domain and two schemes of communications.

When developing parallel software for this problem, we faced some difficulties caused by lack of information of efficiency of a certain method for the solution of particular problem. In this context, we have performed a study whose results are related not only to the problem itself but to a grater extent to tools for its solution. In particular, we compared efficiency of two popular implementation of the MPI standard and studied the behavior of our software when using various ways of memory allocation. Besides, we found some interesting effects which arise when measuring and estimating costs of data exchanges between computational processes. The work was supported by Russian Foundation of Fundamental Researches (grant 08-01-00621-a, 11-01-00224).

欢迎大家参加!