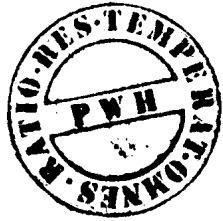


The Sobolev Institute of Mathematics
Siberian Branch of the Russian Academy of Sciences



**THIRD SIBERIAN CONGRESS
ON INDUSTRIAL AND APPLIED
MATHEMATICS**

(INPRIM-98)

dedicated to the memory of S.L.Sobolev (1908-1989)

Book of abstracts

Part II

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- Mathematical Models for Processes in Atmosphere and Ocean
and Reservoir
- Mechanics
- Stability, Control and Optimization

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ИНСТИТУТ МАТЕМАТИКИ ИМ. С.Л.СОБОЛЕВА СО РАН

**ТРЕТИЙ СИБИРСКИЙ КОНГРЕСС
ПО ПРИКЛАДНОЙ И ИНДУСТРИАЛЬНОЙ
МАТЕМАТИКЕ**

(ИНПРИМ-98)

посвященный памяти

С. Л. СОБОЛЕВА (1908–1989)

Тезисы докладов

Часть II

Секции: Вычислительные методы
Математическая геофизика
Математические модели процессов в атмосфере, океане
и водоеме
Механика
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1998

A DEFECT CORRECTION METHOD FOR PARABOLIC SINGULAR PERTURBATION PROBLEMS WITH CONVECTIVE TERMS
P.W.Hemker, G.I.Shishkin, L.P.Shishkina (Amsterdam, The Netherlands; Ekaterinburg). The Dirichlet problem for a singularly perturbed parabolic PDE with convective terms is considered on an interval. The perturbation parameter ϵ takes any values from the half-interval $(0,1]$; the reduced equation is a hyperbolic first-order one. As ϵ tends to zero, a boundary layer appears in the neighbourhood of that end of the interval onto which the convective flow is directed. For such a problem ϵ -uniformly convergent schemes, i.e., schemes the accuracy of which is independent of the parameter, are well known. In particular, it is the scheme on piecewise uniform meshes condensing in the boundary layer. The accuracy of this base scheme is $O\{N^{-1} \ln^2 N + N_0^{-1}\}$, where $N + 1$ and $N_0 + 1$ is the number of the space and time mesh nodes, respectively. The development of schemes with a higher order of the convergence rate is the actual problem. Here ϵ -uniformly convergent schemes with high-order time-accuracy are considered. For the numerical solution of the boundary value problem we use the base scheme and the system of additional corrected schemes. The improvement in time-accuracy of the solution by the base scheme is achieved by correction of the right-hand side. In this correction procedure we use the pre-obtained solution of the base scheme. The order of consistency for the new scheme (after correction) is higher than that for the base scheme. Then we can repeat such a defect correction by a similar way. This method with a sequential correction of the local truncation error allows us to construct ϵ -uniformly convergent schemes with high-order time-accuracy. The efficiency of these theoretical results is illustrated by the results of numerical experiments. This work was supported in part by the Dutch Research Organization NWO under Grant 047.003.017 and by the RFBR under Grant 98-01-000362.

SOLVING SCIENTIFIC PROBLEMS USING MAPLE J.Hřebšček (Brno, Czech Republic). Today, computational simulation means much more than number crunching. Automating algebraic computation began about thirty years ago, with the programs Macsyma and Reduce; newer entries to the field include Derive, MathCAD, Maple and Mathematica. These Symbolic Computation Systems (SCS) directly address academic and research issues in an engineering education. Using SCS, we can get the answers to most of the questions on a traditional freshman mathematical examinations. They can differentiate, integrate, solve systems of equations (e.g. linear, nonlinear, difference, differential and integral) and find various approximations. We can also use SCS to treat questions of combinatorics, knot theory, molecular chemistry, population biology or general relativity. They produce quite nice 2D and 3D graphics, while they spare us the tedium of algebraic manipulation, and let us focus on the real questions rather than on the numerical evaluations. SCS such as Maple V by Waterloo Maple Inc., differ from

для решения плотных плохо обусловленных СЛАУ. Дается обзор результатов, полученных авторами в 1995–97 гг., а также новых выводов, включая оценки эффективности разработанных параллельных алгоритмов. Описывается разработанный авторами пакет LINPAR. Работа поддержана РФФИ, грант 96–01–01557.

ЧИСЛЕННОЕ РЕШЕНИЕ ТРЕХМЕРНЫХ ЗАДАЧ О ПОЛЗУЩЕМ ТЕЧЕНИИ ВЯЗКОЙ ЖИДКОСТИ СО СВОБОДНОЙ ПОВЕРХНОСТЬЮ МЕТОДОМ ГРАНИЧНЫХ ЭЛЕМЕНТОВ В.А. Якутенок (Томск). В работе рассматриваются вопросы, связанные с применением непрямого варианта метода граничных элементов для численного моделирования ползущих течений вязкой жидкости в трехмерном случае. Для этого осуществляется переход от дифференциальной постановки задачи к граничноинтегральной с использованием фундаментальных решений линеаризованных уравнений Навье-Стокса и фиктивных источников неизвестной заранее интенсивности, распределенных по границе области. Полученные граничноинтегральные уравнения дискретизируются при помощи разбиения области на треугольные постоянные элементы. Для вычисления не-сингулярных интегралов используется квадратурная формула Хаммера пятого порядка. Все интегралы с особенностями вычисляются аналитически. Для решения системы линейных уравнений относительно неизвестных интенсивностей источников применяется метод Гаусса с выбором главного элемента. В качестве иллюстрации возможностей данного подхода проведено исследование заполнения вертикального канала квадратного сечения вязкой жидкостью. Исследована эволюция свободной поверхности в широком диапазоне изменения определяющих параметров.

ON SMOOTH DECOMPOSITIONS OF MATRICES T.E. Eirola (Joensuu, Finland). For very good reasons, orthogonal matrices are the backbone of modern matrix computation. They can be computed stably, and provide some of the most successful algorithmic procedures for a number of familiar tasks: finding orthonormal bases, solving least squares problems, eigenvalues and singular values computations, and so forth. The purpose of this work is to consider orthogonal decompositions for matrices depending on a real parameter. Thus we consider k times continuously differentiable matrix functions, i.e., $A \in C^k(\mathbb{R}, \mathbb{C}^{m \times n})$, $k > 0$. We consider a number of basic tasks, such as the QR-, Schur-, and singular value decomposition of A , and their block-analogues. Of course, in general, the matrix $A(t)$ will have, say, an SVD at each given t , but we are interested in conditions and procedures guaranteeing that the factors involved are smooth. This is desirable in several situations. For example, in updating techniques, perturbation theory, and continuation processes. Sufficient conditions for existence of such decompositions are given and differential equations for the factors are derived. Also generic smoothness of these factors is discussed. Joint work with Luca Dieci.