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Supplementary of Abstract



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Contents

Spectral properties of row-stochastic leslie matrix with a near-periodic fecundity pattern
Meiqin Chen, Xiezhang Li 1

Back and forth error compensation and correction methods for semi-lagrangian schemes with application to interface computation using level set method
Todd F. Dupont, Yingjie Liu 2

TDMA and its application in CFD
Lanxiang Wang, Chunguang Li 3

Domain decomposition with non-matching grids for coupling of FEM and natural BEM
Ju-E Yang, Qiya Hu, Dehao Yu 4

Spectral properties of row-stochastic leslie matrix with a near-periodic fecundity pattern

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Abstract

Leslie matrix models are discrete models for the development of age-structured populations. In this paper, we further study the spectral properties of a row-stochastic Lwslie matric A with a near-periodic fecundity pattern of type (k,d,s) based on Kirland's results in 1993. Intervals containing arguments of eigenvalues of A on the upper-half plane are given. Sufficient conditions are derived for the argument of the subdominant eigenvalue of A to be in the interval $[\frac{2\pi}{d}, \frac{2\pi}{d-s}]$ for the cases where $k=1$. A computaciona scheme is suggested to approximate the subdominant eigenvalue when its argument is in $[\frac{2\pi}{d}, \frac{2\pi}{d-s}]$.

Back and forth error compensation and correction methods for semi-lagrangian schemes with application to interface computation using level set method

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Abstract

Level set method uses a level set function, usually an approximate signed distance function, Φ , to represent the interface as the zero set of Φ . When Φ is advanced to the next time level by a transportation equation, its new zero level set will represent the new interface position. We update the level set function Φ forward in time and then backward to get another copy of the level set function, say Φ_1 . Φ_1 and Φ should have been equal if there were no numerical error. Therefore $\Phi - \Phi_1$ provides us the information of error and this information can be used to compensate Φ before updating Φ forward again in time. One nice property is that it has the convenience of possibly improving the temporal and spatial order of an odd order scheme simultaneously. We found that when applying this idea to semi-Lagrangian schemes, e.g., the CIR scheme(which has no CFL restriction, a nice feature for local refinement), the property is still valid (the MacCormack scheme has similar property but it may not be easily applied here). This technique coupled with a simple yet less diffusive redistancing technique produces a very efficient algorithm even for unstructured triangle meshes. Local constant velocity for the first two steps of this algorithm can be used to overcome the singularities in the velocity field wherever they appear. Numerical results will be presented in the talk. Also we would like show some interesting theoretical results for applying this idea to a general linear scheme. For example, the center difference scheme (with forward Euler time stepping) is linearly unstable for hyperbolic equations. Coupled with this algorithm, it becomes stable and the order improves to two.

TDMA and its application in CFD

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Abstract

In computational fluid dynamics (CFD), after discretising the governing equations, large linear algorithm must be solved efficiently. There are two types of solution methods for them: direct methods and iterative methods. In this paper tri-diagonal matrix algorithm (TDMA) will be discussed. It is very interesting that TDMA is actually a direct method for one-dimensional situations, but it can be applied iteratively in a line-by-line fashion to solve multi-dimensional problems. Comparing with other methods, the main advantage of TDMA is computationally inexpensive and with small amount of storage. Numerical examples of one- and two-dimensional problems by using TDMA are presented.

Keywords: TDMA, forward elimination and back-substitution, iterative

Domain decomposition with non-matching grids for coupling of FEM and natural BEM

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Abstract

In this paper, a domain decomposition method with non-matching grids is discussed by coupling of finite element method (FEM) and natural boundary element method (BEM) for problems over unbounded domains. We apply a Dirichlet-Neumann alternating method to solve the coupled system. The theoretical results as well as the numerical examples show that this discrete Dirichlet-Neumann iteration is optimal, i.e. independent of the finite element mesh size.

Keywords: domain decomposition, non-matching grids, multiplier space, error estimate, Dirichlet-Neumann iteration.

(MOS) subject classification:65N30, 65N55

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