MS/9

Iterative Substructuring Methods for Elliptic Problems Partitioned into Many Substructures

Room : Gaston Berger

Finite element problems can often naturally be partitioned into subproblems corresponding to subregions into which the region has been partitioned or from which it was originally assembled. A variety of iterative methods is being developed in which the interaction across the curves or surfaces which divide the region is handled by a conjugate gradient method. Various algorithms of this kind will be discussed with particular emphasis on the case of many substructures and the relation of these methods to multigrid techniques.

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On the Tradeoff Between Global Coupling and Communication Cost in Domain Decomposition Algorithms

Room : Gaston Berger

Elliptic problems are characterized by a global coupling of the variables in the computational domain. Domain decomposition algorithms can be viewed as methods for reducing this global coupling to one involving only the interfaces between the subdomains. For simple problems, such as constant coefficient problems on regular domains, this reduced coupling can be handled exactly and efficiently, which leads to fast direct solvers. For more complicated problems, however, the coupling becomes expensive to handle exactly. Moreover, on parallel computers, global coupling requires expensive global communication. Therefore, it may be desirable to approximate the global coupling by preconditioners requiring weaker local couplings. We are interested in studying the tradeoff between the goodness of a preconditioner versus the communication cost it requires.

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Domain Decomposition Method for Problems with Non-Conforming Finite Elements

Room : Gaston Berger

The domain decomposition method for second order elliptic partical differential equations is considered. The higher order non-conforming finite discretization is employed. A substructuring with intersecting separators is introduced. New results are established. The proposed method allows for efficient solution of the original problem.

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The Construction of Preconditioners for Elliptic Problems by Substructuring

Room : Gaston Berger

We will consider the problem of solving the algebraic system of equations which result from finite element (or finite difference) discretizations of elliptic boundary value problems defined on three dimension Euclidean space. We develop preconditioners for such systems based on substructing (also known as domain decomposition). The resulting algorithms are well suited to emerging parallel computing architectures. We describe two techniques for developing these preconditioners both of which are applicable to domains with general geometries. A theory for the analysis of the condition number for the resulting preconditioned system will be given.

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MS/10

Boundary Control Systems and Singular Control Systems

Room : C.I.C. Annex I

It is well known that the action of a linear state feedback in a distributed parameter control system with distributed and boundary control may take a homogeneous linear state space singular form. This is an ill posed problem. In this paper the theory of singular systems is used to give answers to the problems of existence of feedback such that the closed loop is a consistent system, coefficient assignability of the closed loop system and effect of this on the boundary control problem, and finally relationship between the zeros and the invariant subspaces. Finally we present similarities of some problems in singular systems to time delay systems.

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On Sensitivity in Semistate Described Linear Systems

Room : C.I.C. Annex I

This paper presents a theory of sensitivity to go with semistate described linear time - invariant systems. We begin with the canonical semistate equations of linear time-invariant systems of the form

$$A\dot{x} + Bx = Du$$

$$y = Lx$$

where u and y are the system input and output variables and A, B, D and L are constant matrices (with A generally singular). Considering a para-

meter a of the system we investigate the behavior of the system with respect to changes in the a. In particular it is shown that, as with state-variable systems, the vector dx/da satisfies an almost identical set of canonical semistate equations. From this a discussion is given on the sensitivity properties of the system and comparisons are made with similar state variable circuits.

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A Brief Survey of Geometric Theory for Singular Systems

Room : C.I.C. Annex I

In this paper some recent results on the geometric theory of the linear singular system

$$E\dot{x} = Ax + Bu$$

will be discussed. The notions of (A,E,R(B)) - invariance will be reviewed, and they will be used to compute the reachable subspace. Preliminary results on extending to singular systems the concept of reachability subspace will be presented. The use of both subspace recursions and matrix algorithms to compute subspaces will be covered. Some open problems will be discussed, including the disturbance decoupling problem using constant and proportional feedback and system inversion.

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Recent Results in Realization Theory for Semi State Systems

Room : C.I.C. Annex I

Several algorithms are presented for the construction of minimal, finite dimensional realizations of linear, time - invariant, discrete - time, singular systems, when the external description, such as the impulse response matrix or the frequency response matrix are given. The presented algorithms use the theory of Markov parameters for singular systems or the Markov parameters and moments combined, or Taylor series expansion about a general point "a", or use simplified version of Taylor series expansion about an arbitrary point "a".
Advantages, disadvantages and comparisons between each other algorithm is discussed. Finally the applicability of the above to state space models is shown via various illustrative examples.

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MS/11

FORTRAN 8X - The Emerging Standard

Room : Louis Armand I

Since 1979, the Fortran standardization committee, X3J3, has been labouring over a draft for the next version of the standard. Its initial intention of publishing this draft in 1982 was hopelessly optimistic, and at best it may be ready this year. However, a number of fundamental issues have been thrown up over the past two years, such that it is clear that unanimity cannot be achieved: efficienc versus functionality; safety versus obsolescence; small and simple or big and powerful?
This paper reviews the current state and content of Fortran 8x.

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The FORTRAN 8X Array Features

Room : Louis Armand I

Fortran 8x contains extensive features for handling arays. These will lead to shorter and more readable source programs that compile to more efficient object code, particularly on vector or parallel target machines. The array features will be summarized in this talk.

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Generalised Precision Features of FORTRAN 8X

Room : Louis Armand I

Fortran 8X contains features to provide portable selection of floating point approximation quality, and provision for user definition of procedures that will be generic over machine "precisions". These facilities are described in some detail along with their possible impact on performance.

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Abstracts

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