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*On the conditioning of the nonsymmetric eigenproblem: theory and software, October [Z. Bai, J. Demmel, A. McKenney] on calendrierdelascience.com *FREE* shipping on qualifying offers.*

Heath , Henk A. We survey general techniques and open problems in numerical linear algebra on parallel architectures. We first discuss basic principles of parallel processing, describing the costs of basic operations on parallel machines, including general principles for constructing efficient algorithms. We illustrate these principles using current architectures and software systems, and by showing how one would implement matrix multiplication. Then, we present direct and iterative algorithms for solving linear systems of equations, linear least squares problems, the symmetric eigenvalue problem, the nonsymmetric eigenvalue problem, and the singular value decomposition. We consider dense, band and sparse matrices. Continuation and Path Following by Eugene L. Allgower, Kurt Georg , " Introduction Continuation, embedding or homotopy methods have long served as useful Introduction Continuation, embedding or homotopy methods have long served as useful theoretical tools in modern mathematics. Leray and Schauder refined the tool and presented it as a global result in topology, viz. Georg may be traced back at least to Lahaye The problem of computing the intersection of parametric and algebraic curves arises in many applications of computer graphics and geometric and solid modeling. Previous algorithms are based on techniques from elimination theory or subdivision and iteration. The former is however, restricted to low The former is however, restricted to low degree curves. This is mainly due to issues of efficiency and numerical stability. In this paper we use elimination theory and express the resultant of the equations of intersection as a matrix determinant. The matrix itself rather than its symbolic determinant, a polynomial, is used as the representation. The problem of intersection is reduced to computing the eigenvalues and eigenvectors of a numeric matrix. The main advantage of this approach lies in its efficiency and robustness. Moreover, the numerical accuracy of these operations is well understood. For almost all cases we are able to compute accurate answers in 64 bit IEEE floating point arithmetic. The dense nonsymmetric eigenproblem is one of the hardest linear algebra problems to solve effectively on massively parallel machines. The tools are meant to be used in different combinations on different problems and architectures. In this paper, we will describe these tools which include basic block matrix computations, the matrix sign function, 2-dimensional bisection, and spectral divide and conquer using the matrix sign function to find selected eigenvalues. We also outline how we deal with ill-conditioning and potential instability. Numerical examples are included. A future paper will discuss error analysis in detail and extensions to the generalized eigenproblem. The spectral decomposition of nonsymmetric matrices on distributed memory parallel computers by Z. Comput , " The implementation and performance of a class of divide-and-conquer algorithms for computing the spectral decomposition of nonsymmetric matrices on distributed memory parallel computers are studied in this paper. After presenting a general framework, we focus on a spectral divide-and-conqu After presenting a general framework, we focus on a spectral divide-and-conquer SDC algorithm with Newton iteration. Although the algorithm requires several times as many floating point operations as the best serial QR algorithm, it can be simply constructed from a small set of highly parallelizable matrix building blocks within Level 3 basic linear algebra subroutines BLAS. Efficient implementations of these building blocks are available on a wide range of machines. In some ill-conditioned cases, the algorithm may lose numerical stability, but this can easily be detected and compensated for. Our performance model predicts the performance reasonably accurately. To take advantage of the geometric nature of SDC algorithms, we have designed a graphical user interface to let the user choose the spectral decomposition according to specified regions in the complex plane. Show Context Citation Context All these methods suffer from the use of fine-grain parallelism, instability, slow or misconvergence in the presence of clustered eigenvalues of the original problem or In this paper we present an algorithm for the eigenvalue problem of symmetric tridiagonal matrices. The method directly evaluates eigenvalues and uses inverse iteration as an option when eigen The method directly evaluates eigenvalues and uses inverse iteration as an option when eigenvectors are needed. It is fully parallel, and competitive in speed with the most efficient QR algorithm in serial mode. On the other hand, our algorithm is as accurate as any standard algorithm for the symmetric tridiagonal eigenproblem and enjoys the flexibility in evaluating partial spectrum. While our algorithm does not employ the homotopy continuation method directly, the design of our algorithm is critically based on the consideration of the structure of the eigenvalue curves of the h Trading off Parallelism and Numerical Stability by J. Demmel , " The fastest parallel algorithm for a problem may be significantly less stable numerically than the fastest serial algorithm. We illustrate this phenomenon by a series of examples drawn from numerical linear algebra. We also show how some of these instabilities may be mitigated by better floating poi We also show how some of these instabilities may be mitigated by better floating point arithmetic. Reichel , " The polynomials OE j arise in time series analysis and are often referred to as Szego polynomials or Levinson polynomials. Knowledge about the location of their zeros is im Knowledge about the location of their zeros is important for frequency analysis of time series and for filter implementation. We present fast algorithms for computing the zeros of the polynomials OE n based on the observation that the zeros are eigenvalues of a rank-one modification of a unitary upper Hessenberg matrix Hn 0 of order n. The algorithms first determine the spectrum of Hn 0 by one of several available schemes that require only O n 2 arithmetic operations. The eigenvalues of the rank-one perturbation are then determined from the eigenvalues of Hn 0 by a continuation method. The computation of the n zeros of OE n in this manner typically requires only O n 2 arithmetic operations. The algorithms have a structure that Progress in the numerical solution of the nonsymmetric eigenvalue problem by Zhaojun Bai , " With the growing demands from disciplinary and interdisciplinary fields of science and engineering for the numerical solution of the nonsymmetric eigenvalue problem, competitive new techniques have been developed for solving the problem. In this paper we examine the state of the art of the algorithm In this paper we examine the state of the art of the algorithmic techniques and the software scene for the problem. Some current developments are also outlined. Although some successful aspects have been seen, more investigation is needed to deal with the possible divergence of the iteration and identification p Eigenvalue Computation in the 20th Century by Gene H. This paper sketches the main research developments in the area of computational methods for eigenvalue problems during the 20th century. The earliest of such methods dates back to work of Jacobi in the middle of the nineteenth century. Since computing eigenvalues and vectors is essentially more c Since computing eigenvalues and vectors is essentially more complicated than solving linear systems, it is not surprising that highly significant developments in this area started with the introduction of electronic computers around In the early decades of this century, however, important theoretical developments had been made from which computational techniques could grow. Research in this area of numerical linear algebra is very active, since there is a heavy demand for solving complicated problems associated with stability and perturbation analysis for practical applications.

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On the conditioning of the nonsymmetric eigenproblem: theory and software On the conditioning of the nonsymmetric eigenproblem: theory and software. by Bai, Z.

Heath , Henk A. We survey general techniques and open problems in numerical linear algebra on parallel architectures. We first discuss basic principles of parallel processing, describing the costs of basic operations on parallel machines, including general principles for constructing efficient algorithms. We illustrate these principles using current architectures and software systems, and by showing how one would implement matrix multiplication. Then, we present direct and iterative algorithms for solving linear systems of equations, linear least squares problems, the symmetric eigenvalue problem, the nonsymmetric eigenvalue problem, and the singular value decomposition. We consider dense, band and sparse matrices. Modern microprocessors can achieve high performance on linear algebra kernels but this currently requires extensive machine-specific hand tuning. We have developed a methodology whereby near-peak performance on a wide range of systems can be achieved automatically for such routines. Second, rather than code by hand, we produce parameterized code generators. Third, we write search scripts that and the best parameters for a given system. The problem of computing the intersection of parametric and algebraic curves arises in many applications of computer graphics and geometric and solid modeling. Previous algorithms are based on techniques from elimination theory or subdivision and iteration. The former is however, restricted to low The former is however, restricted to low degree curves. This is mainly due to issues of efficiency and numerical stability. In this paper we use elimination theory and express the resultant of the equations of intersection as a matrix determinant. The matrix itself rather than its symbolic determinant, a polynomial, is used as the representation. The problem of intersection is reduced to computing the eigenvalues and eigenvectors of a numeric matrix. The main advantage of this approach lies in its efficiency and robustness. Moreover, the numerical accuracy of these operations is well understood. For almost all cases we are able to compute accurate answers in 64 bit IEEE floating point arithmetic. A memory model for scientific algorithms on graphics processors by Naga K. We present a memory model to analyze and improve the performance of scientific algorithms on graphics processing units GPUs. Our memory model is based on texturing hardware, which uses a 2D block-based array representation to perform the underlying computations. We incorporate many characteristics Moreover, we present techniques to improve the performance of nested loops on GPUs. In order to demonstrate the effectiveness of our model, we highlight its performance on three memory-intensive scientific applications â€” sorting, fast Fourier transform and dense matrix-multiplication. Eective exploitation of Computational Grids can only be achieved when applica-tions are fully integrated with the Grid middleware and the underlying computa-tional resources. Fundamental to this exploitation is information. Information about the structure and behaviour of the application, the capabi Information about the structure and behaviour of the application, the capability of the computational and networking resources, and the availability and access to these resources by an individual, a group or an organisation. ICENI is a platform independent framework that uses open and extensible XML derived protocols, within a framework built using Java and Jini, to explore eective application execution upon distributed federated resources. We match a high-level application specication, dened as a network of components, to an opti-mal combination of the currently available component implementations within our Grid environment, by utilising a system of composite performance modelling. We demonstrate the eectiveness of this architecture through high-level specication and solution of a set of linear equations by automatic and optimal resource and implementation selection. The selection of the implementations for the run-time representation also provides opportunities for optimising the component application alongside its deployment. The dense nonsymmetric eigenproblem is one of the hardest linear algebra problems to solve effectively on massively parallel machines. The tools are meant to be used in different combinations on different problems and architectures. In this paper, we will describe these tools which include basic block matrix computations, the matrix sign function, 2-dimensional bisection, and spectral divide and conquer using the matrix sign function to find selected eigenvalues. We also outline how we deal with ill-conditioning and potential instability. Numerical examples are included. A future paper will discuss error analysis in detail and extensions to the generalized eigenproblem. The inverse kinematics of serial manipulators is a central problem in the automatic control of robot manipulators. The main interest has been in inverse kinematics of a six revolute 6R jointed manipulator with arbitrary geometry. It has been recently shown that the joints of a general 6R manipula It has been recently shown that the joints of a general 6R manipulator can orient themselves in 16 different configurations at most , for a given pose of the end--effector. However, there are no good practical solutions available, which give a level of performance expected of industrial manipulators. In this paper, we present an algorithm and implementation for efficient inverse kinematics for a general 6R manipulator. When stated mathematically, the problem reduces to solving a system of multivariate equations. We make use of the algebraic properties of the system and the symbolic formulation used for reducing the problem to solving a univariate polynomial. However, the polynomial is expressed as a matrix determinant and its roots are computed by reducin Show Context Citation Context This is in contrast with expanding a symbolic determinant to compute a degree 16 polynomial and thereby, computing its roots. For almost all instances of the problem we are able to compute accurate Current geometric and solid modeling systems use semi-algebraic sets for defining the boundaries of solid objects, curves and surfaces, geometric constraints with mating relationship in a mechanical assembly, physical contacts between objects, collision detection. It turns out that performing many o It turns out that performing many of the geometric operations on the solid boundaries or interacting with geometric constraints is reduced to nding common solutions of the polynomial equations. Current algorithms in the literature based on symbolic, numeric and geometric methods su er from robustness, accuracy or efficiency problems or are limited to a class of problems only. In this paper we present algorithms based on multipolynomial resultants and matrix computations for solving polynomial systems. These algorithms are based on the linear algebra formulation of resultants of equations and in many cases there is an elegant relationship between the matrix structures and the geometric formulation. The resulting algorithm involves singular value decompositions, eigendecompositions, Gauss elimination etc. In the context of floating point computation their numerical accuracy is well understood. We also present techniques to make use of the structure of the matrices to improve Show Context Citation Context This is in contrast with finding roots of high degree univariate polynomials. The rest of the paper is organized in the following manner. In Section 2 we review the 2 results from elimination theory. We consider sparse as well as dense pol We present MAPC, a library for exact representation of geometric objects -- specifically points and algebraic curves in the plane. Our library makes use of several new algorithms, which we present here, including methods for nding the sign of a determinant, finding intersections between two curves, Our library makes use of several new algorithms, which we present here, including methods for nding the sign of a determinant, finding intersections between two curves, and breaking a curve into monotonic segments. These algorithms are used to speed up the underlying computations. The point classes can be used to represent points known in a variety of ways e. The curve class can be used to represent a portion of an algebraic curve. We have used MAPC for applications dealing with algebraic points and curves, including sorting points along a curve, computing arrangement of curves, medial axis computations, and boundary evaluation on curved primitives. As compared to earlier algorithms and implementations utilizing exact arithmetic, our library is able to achieve more than an order of magnitude improvement in performance. Some of the geometric problems of interest to molecular biologists have macroscopic analogues in the field of robotics. Two examples of such analogies are those between protein docking and model-based perception, and between ring closure and inverse kinematics. Molecular dynamics simulation, too, ha Molecular dynamics simulation, too, has much in common with the study of robot dynamics. In this paper we give a brief survey of recent work on these and related problems. This latter problem has been well studied, and efficient and numerically stable solutions are available e. In most cases, ordinary double floating

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Buy On the Conditioning of the Nonsymmetric Eigenproblem: Theory and Software on calendrierdelascience.com FREE SHIPPING on qualified orders On the Conditioning of the Nonsymmetric Eigenproblem: Theory and Software: Z Bai, James Weldon Demmel, A McKenney: calendrierdelascience.com: Books.

Yang , " The goal is to provide some understanding of the underlying algorithm, expected behavior, additional references, and capabilities as well as limitations of the The goal is to provide some understanding of the underlying algorithm, expected behavior, additional references, and capabilities as well as limitations of the software. This is a more refined indicator Matrix computations are both fundamental and ubiquitous in computational science and its vast application areas. Along with the development of more advanced computer systems with complex memory hierarchies, there is a continuing demand for new algorithms and library software that efficiently utilize Along with the development of more advanced computer systems with complex memory hierarchies, there is a continuing demand for new algorithms and library software that efficiently utilize and adapt to new architecture features. Recursion allows for efficient utilization of a memory hierarchy and generalizes existing fixed blocking by introducing automatic variable blocking that has the potential of matching every level of a deep memory hierarchy. Novel recursive blocked algorithms offer new ways to compute factorizations such as Cholesky and QR and to solve matrix equations. In fact, the whole gamut of existing dense linear algebra factorization is beginning to be reexamined in view of the recursive paradigm. Use of recursion has led to using new hybrid data structures and optimized superscalar kernels. The results we survey include new algorithms and library software implementations for level 3 kernels, matrix factorizations, and the solution of general systems of linear equations and several common matrix equations. The problem of computing the intersection of parametric and algebraic curves arises in many applications of computer graphics and geometric and solid modeling. Previous algorithms are based on techniques from elimination theory or subdivision and iteration. The former is however, restricted to low The former is however, restricted to low degree curves. This is mainly due to issues of efficiency and numerical stability. In this paper we use elimination theory and express the resultant of the equations of intersection as a matrix determinant. The matrix itself rather than its symbolic determinant, a polynomial, is used as the representation. The problem of intersection is reduced to computing the eigenvalues and eigenvectors of a numeric matrix. The main advantage of this approach lies in its efficiency and robustness. Moreover, the numerical accuracy of these operations is well understood. For almost all cases we are able to compute accurate answers in 64 bit IEEE floating point arithmetic. Show Context Citation Context More details on condition numbers are given in [GL89, Wil65]. In our intersection algorithm, we will be performing computations like matrix inversion and computing eigenvalues and eigenvectors of a matrix. Therefore, we will be concerned with the numerical acc Skew-Hamiltonian and Hamiltonian eigenvalue problems: Skew-Hamiltonian and Hamiltonian eigenvalue problems arise from a number of applications, particularly in systems and control theory. The preservation of the underlying matrix structures often plays an important role in these applications and may lead to more accurate and more efficient computation The preservation of the underlying matrix structures often plays an important role in these applications and may lead to more accurate and more efficient computational methods. We will discuss the relation of structured and unstructured condition numbers for these problems as well as algorithms exploiting the given matrix structures. Applications of Hamiltonian and skew-Hamiltonian eigenproblems are briefly described. The sensitivity of computational control problems by Nicholas J. Mag , " What factors contribute to the accurate and efficient numerical solution of problems in control systems analysis and design? Although numerical methods have been used for many centuries to solve problems in science and engineering, the importance of computation grew tremendously with the advent of d Although numerical methods have been used for many centuries to solve problems in science and engineering, the importance of computation grew tremendously with the advent of digital computers. It became immediately clear that many of the classical analytical and numerical methods and algorithms could not be implemented directly as computer codes, although they were well suited for hand computations. What was the reason? When doing computations by hand a person can choose the accuracy of each elementary calculation and then estimate, based on intuition and experience, its influence on the final result. In contrast, when computations are done automatically, intuitive error control is usually not possible and the effect of errors on the intermediate calculations must be estimated in a more systematic way. Due to this observation, starting.

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The basic mathematical theory behind this approach is reviewed and is followed by a discussion of the numerical considerations of the actual implementation. The numerical algorithm has been tested on thousands of matrices on both a Cray-2 and an IBM RS/ Model workstation.

The problem of computing the intersection of parametric and algebraic curves arises in many applications of computer graphics and geometric and solid modeling. Previous algorithms are based on techniques from elimination theory or subdivision and iteration. The former is however, restricted to low The former is however, restricted to low degree curves. This is mainly due to issues of efficiency and numerical stability. In this paper we use elimination theory and express the resultant of the equations of intersection as a matrix determinant. The matrix itself rather than its symbolic determinant, a polynomial, is used as the representation. The problem of intersection is reduced to computing the eigenvalues and eigenvectors of a numeric matrix. The main advantage of this approach lies in its efficiency and robustness. Moreover, the numerical accuracy of these operations is well understood. For almost all cases we are able to compute accurate answers in 64 bit IEEE floating point arithmetic. We study the approximate GCD of two univariate polynomials given with limited accuracy or, equivalently, the exact GCD of the perturbed polynomials within some prescribed tolerance. A perturbed polynomial is regarded as a family of polynomials in a classification space, which leads to an accurate an A perturbed polynomial is regarded as a family of polynomials in a classification space, which leads to an accurate analysis of the computation. Considering only the Sylvester matrix singular values, as is frequently suggested in the literature, does not suffice to solve the problem completely, even when the extended euclidean algorithm is also used. Further use of the subresultant matrices singular values yields an approximate syzygy of the given polynomials, which is used to establish a gap theorem on certain singular values that certifies the maximum-degree approximate GCD. This approach leads directly to an algorithm for computing the approximate GCD polynomial. The inverse kinematics of serial manipulators is a central problem in the automatic control of robot manipulators. The main interest has been in inverse kinematics of a six revolute 6R jointed manipulator with arbitrary geometry. It has been recently shown that the joints of a general 6R manipula It has been recently shown that the joints of a general 6R manipulator can orient themselves in 16 different configurations at most , for a given pose of the end--effector. However, there are no good practical solutions available, which give a level of performance expected of industrial manipulators. In this paper, we present an algorithm and implementation for efficient inverse kinematics for a general 6R manipulator. When stated mathematically, the problem reduces to solving a system of multivariate equations. We make use of the algebraic properties of the system and the symbolic formulation used for reducing the problem to solving a univariate polynomial. However, the polynomial is expressed as a matrix determinant and its roots are computed by reducin Show Context Citation Context We actually verify the accuracy of these computations by computing the condition number of the eigenvalue and the condition number of a cluster of eigenvalues. Routines to compute this condition num In this paper, preliminary research results on a new algorithm for finding all the eigenvalues and eigenvectors of a real diagonalizable matrix with real eigenvalues are presented. The basic mathematical theory behind this approach is reviewed and is followed by a discussion of the numerical consi The basic mathematical theory behind this approach is reviewed and is followed by a discussion of the numerical considerations of the actual implementation. The results of these tests are presented. Finally, issues concerning the parallel implementation of the algorithm are discussed. Computation of all the eigenvalues and eigenvectors of a dense matrix is essential for solving problems in many fields. The ever-increasing computational power available from modern supercomputers offers the potenti Canny - In Proc. Robotics and Automation , " The main interest has been in inverse kinematics of a six revolute jointed manipulator with arbitrary geometry. It has been recently shown that the joints of a general 6R manipulator In this paper, we present an algorithm and implementation for real time inverse kinematics for a general 6R manipulator. We make use of the algebraic properties of the system and the techniques used for reducing the problem to solving a univariate polynomial. However, the polynomial is expressed as a matrix determinant and its roots are computed by reducing to an eigenva Given an eigenvector V, we use its structure, 16 , to The paper considers a possible approach to construction of high quality preconditionings for solving large sparse unsymmetric off-diagonally dominant possibly indefinite linear systems. We are interested in construction of an efficient iterative method which does not require from the user a prescrip The suggested preconditioning strategy is based on consecutive translations of groups of spread eigenvalues into a vicinity of the point 1. We formulate the optimization probl Dongarra, Sven Ammarling , " This paper describes two methods for computing the invariant subspace of a matrix. The first method involves using transformations to interchange the eigenvalues. The matrix is assumed to be in Schur form and transformations are applied to interchange neighboring blocks. The blocks can be either o The blocks can be either one by one or two by two. The second method involves the construction of an invariant subspace by a direct computation of the vectors, rather than by applying transformations to move the desired eigenvalues to the top of the matrix. Introduction In this paper we consider the computation of the invariant subspace of a matrix corresponding to some given group of eigenvalues. Potentially, the Schur factorization provides a method for computing such invariant subspaces, with the important numerical property that it provides an orthonormal basis for such spaces. Finding zeros of algebraic sets is a fundamental problem in scientific and geometric computation. It arises in symbolic and numeric techniques used to manipulate sets of polynomial equations. In this paper, we outline algorithms and applications for solving zero and one dimensional algebraic sets us In this paper, we outline algorithms and applications for solving zero and one dimensional algebraic sets using matrix computations. These algorithms make use of techniques from elimination theory and reduce the problem to finding singular sets of matrix polynomials. We make use of algorithms for eigendecomposition, singular value decomposition and Gaussian elimination to compute the singular sets. These algorithms have been implemented and perform very well in practice. We describe their application to computing conformations of molecular chains, inverse kinematics of serial robots, solid modeling and manufacturing. More details of its application to finding solutions of polynomial equations are given in [Man92]. Such analysis is well developed for eigenvalues of a matrix and no equivalent analysis is known for Proceedings of the international symposium on Symbolic and algebraic computation , " In the univariate case our method gives an alternative to known approximate square-free factorization algorithms which is simpler and its accuracy is better understood. In contrast, our method reorders the eigenvalues of all multiplication matrices simultaneously without approximating the eigenvalues, grouping one eigenvalue f Approximate radical for clusters: To compute the numerical nullspace of the matrix of traces we propose to use Gauss elimination with pivoting or singular value decomposition. See [8] and [49]. We now compute the matrix R using Definition 2.

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