Dr. Constantine Bekas

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Degrees

Computer Engineering & Informatics Dept., University of Patras, Greece, 1993-2003
Ph.D. in Computer Science (Scientific Computing), June 2003.
Area of specialization: *Computation of Pseudospectra*.
M.S. in Computer Engineering & Informatics, 2001.
Diploma in Computer Engineering & Informatics, 1998.

Honors and Awards

Bodossaki Foundation Graduate Fellowship, 1999 - 2003
(extension of 6 months beyond maximum of 3 years).
Technical Chamber of Greece award for undergraduate academic excellence, 2000.
Computer Engineering & Informatics Dept. Graduate Fellowship
(awarded to first year graduate students only) 1998-1999.

Research Experience

***Post-doctoral Research*:** Computer Science and Eng. Dept., University of Minnesota, Aug. 2003 - present (research advisor: Prof. Y. Saad)

- Domain decomposition methods and algebraic susbtructuring methods for large scale eigenvalue problems.
- Computational materials science, electronic structure calculations.
- Parallel multilevel linear solvers.
- Numerical (spectral) algorithms for data mining.
- Large scale pseudospectra calculation.
- Problem solving environments.
- High performance computing. Multithreaded libraries.
- Higly and widely distributed computation.

***Doctoral Research*:** Department of Computer Engineering & Informatics, University of Patras, 1998-2003 (research advisor: Dr. E. Gallopoulos).

- Parallel numerical path following algorithms for the efficient approximation of matrix pseudospectra.

- Iterative transfer function methods for the efficient approximation of the norm of the resolvent of a matrix for multiple complex shifts, in the context of the computation of matrix pseudospectra.
- Iterative Krylov methods for the computation of the smallest singular value of large and sparse matrices.
- Implementation of algorithms for the computation of pseudospectra on both shared (using `OpenMP`) and distributed (using `MPI, PVM`) memory parallel platforms. Study and addressing of load balance issues.
- Integration of the above pseudospectra computing methods in a `MATLAB` parallel solving environment that runs on networks of workstations.
- Development of a `MATLAB` toolbox that enables calls of multithreaded libraries in `MATLAB` on `Windows 2000` PC platforms.

***Undergraduate Research*:** Department of Computer Engineering & Informatics, University of Patras, 1996-1998 (research advisor: Prof. E. Gallopoulos).

- Development of a parallel path following method for the computation of the pseudospectra of a matrix. The method improved an existing serial algorithm by minimizing its causes of failure and by introducing coarse grain parallelism.
- Study and implementation of existing and new parallel algorithms for the computation of matrix pseudospectra on a `cc-NUMA Origin 2000` parallel machine.

***Participation in Research Projects*:**

- European Union research project STABLE (INCO-COPERNICUS 960237), Jan. 1997 - Dec. 1998. Collaboration with: V. Simoncini, University of Bologna, Italy and B. Philippe, Irisa, France.
- Greek Secretariat of Research and Development, Project $\Pi ENE\Delta - 97$, Jan, 1999 - Aug. 2001. Collaboration with: A. Boudouvis, National Technical University of Greece and Y. Kevrekides, Princeton University, USA.
- NSF/ACIR 0000443 and NSF/ACIR 0305120. Parallel Large Scale Sparse Linear System Solvers: New Methods and Paradigms, Aug. 2003 -. Collaboration with Y. Saad and M. Sosonkina.
- NSF-DMR. High performace algorithms for electronic materials. Aug. 2003 - Collaboration with Y. Saad and J. Chelikowsky.

Research Interests (see research statement for a detailed discussion)

- **Scientific Computing:** Numerical linear algebra, large scale pseudospectra, eigenvalue and linear system problems. Applications of linear algebra.
- **Computational materials science**: electronic structure calculations.
- **Data mining of high dimensional data**. Efficient clustering and retrieval algorithms.
- **High Performance and Parallel Computing:** Performance and scalability issues in shared memory platforms, distributed computing, GRID computing issues, parallel architectures. High performance multithreaded software libraries.
- **Problem Solving Environments:** Parallel PSE's and their efficient application to large scale real world problems.

Teaching Experience and Student Advising

- **Teaching Assistant:** 343 Scientific Computing I, 443 Scientific Computing II, Department of Computer Engineering & Informatics, University of Patras, 1998 - 2002.
- **Instructor:** Seminar in mathematical methods with `MATLAB`, Hellenic Mathematical Society, Spring 1999.
- **Invited lectures:** M102C Parallel and Distributed Computing and Applications, Department of Electrical & Computer Engineering, University of Patras, 2000-2002.
- **Undergraduate Student Advising**: University of Patras, Prof. Gallopoulos group, 1998 - 2003.
- **Graduate Student Advising**: University of Minnesota, Prof. Saad's group, Aug. 2003 -.

University Services

- **System Administrator, University of Patras:** Parallel computing facility (8 processor Origin 2000) of the University of Patras, 1998 - 2003. Responsible for software-hardware maintenance and for consulting the users in parallel computing issues.
- **Graduate Student Representative, University of Patras:** Member of the General Assembly of the Department of Computer Engineering & Informatics, 2000-2002. Member of the Committee for Graduate Studies, Department of Computer Engineering & Informatics, 2000.

Reviewing Services

- 15th ACM International Conference on Supercomputing, 2001.
- 18th ACM International Conference on Supercomputing, 2004.
- Parallel Computing.
- BIT.
- Applied Numerical Mathematics.

Conference Services

- Handling of submitted papers and compilation of proceedings of the "15th ACM International Conference on Supercomputing", 2001.
- Local arrangements for IFIP WG2.5 Group Workshop: "Computational Science in the 21st Century" May 21-24 1998, University of Patras, Greece.
- Web administration for the "1st International Seminar on Mathematics of Computers and Decision Making", May 25-26, 2001, Patras, Greece.

Professional Memberships

- Member of the Technical Chamber of Greece.

- Member of SIAM, special interest groups: Linear Algebra, Supercomputing.

Language Skills

- Greek (native).
- English (fluently). Cambridge certificate of Proficiency in English.
- German (basic, I have followed a two year course).

Technical Skills

- Fortan 77/90, C, Matlab
- OpenMP, Multithreaded libraries, PVM, MPI
- Windows 2000, Irix 6.x (administrator)

References

1. Dr. Y. Saad (post-doc advisor)
   Computer Science and Engineering Dept.
   University of Minnesota,
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   email: saad@cs.umn.edu
2. Dr. J. Chelikowsky
   Chemical Eng. & Materials Science Dept.
   University of Minnesota,
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   email: jrc@msi.umn.edu
3. Dr. E. Gallopoulos (Ph.D. advisor)
   Computer Engineering and Informatics Department
   University of Patras
   26500, Patras, Greece
   email: stratis@hpclab.ceid.upatras.gr
4. Dr. V. Simoncini
   Department of Mathematics
   University of Bologna
   Piazza di Porta S. Donato, 5
   40127 Bologna, Italy
   email: valeria@dm.unibo.it
5. Dr. B. Philippe
   IRISA/INRIA
   Campus Universitaire de Beaulieu
   Avenue du General Leclerc
   35042 Rennes Cedex, France
   Bernard.Philippe@irisa.fr

6. Dr. A. Stathopoulos
   Department of Computer Science
   The College of William and Mary
   P.O. Box 8795
   Williamsburg, VA 23187-8795, USA
   email: andreas@cs.wm.edu

7. Dr. G. Giannakis
   Electrical & Computer Engineering Department
   University of Minnesota,
   EE/CS Bld., 200 Union Street SE, 55455, Minneapolis, MN, USA
   email: georgios@ece.umn.edu

8. Dr. A. Boudouvis
   Department of Chemical Engineering
   National Technical University of Athens
   15780, Athens, Greece
   boudouvi@chemeng.ntua.gr

Publications and Presentations

Refereed journal papers

1. C. Bekas and E. Gallopoulos. "Cobra: Parallel Path Following for Computing the Matrix Pseudospectrum", Parallel Computing, v. 27, pp. 1879-1896, 2001.

2. C. Bekas and E. Gallopoulos. "Parallel Computation of Pseudospectra by Fast Descent", Parallel Computing, v. 28, pp. 223-242, 2002.

3. E. Kokiopoulou, C. Bekas and E. Gallopoulos. "Computing Smallest Singular Triplets with Implicitly Restarted Lanczos Bidiagonalization". To appear in J. Num. Appl. Mathematics, 49 (1), pp. 39-61. 2004.

4. C. Bekas, E. Kokiopoulou and E. Gallopoulos. "The Design of a Distributed MATLAB-based Environment for Computing Pseudospectra". Future Generation Computer Systems, 21(6), pp. 930-941, 2005.

5. C. Bekas and Y. Saad. "Computation of Smallest Eigemvalues using Spectral Schur Complements". To appear in SIAM J. Scient. Comp., 2004.

6. C. Bekas, Y. Saad, M. Tiago and J. Chelikowsky. "Computing Charge Densities with Partially Reorthogonalized Lanczos". To appear in Comp. Phys. Comm., 2005.

Refereed conference proceedings

1. C. Bekas, E. Kokiopoulou, I. Koutis and E. Gallopoulos. "Towards the Effective Parallel Computation of Matrix Pseudospectra", ACM, ICS 2001, Sorrento, Italy, pp 261-270.

2. C. Bekas, E. Kokiopoulou, E. Gallopoulos and V. Simoncini. "Parallel Computation of Pseudospectra Using Transfer Functions on a MATLAB-MPI Cluster Platform", D. Kranzlmuller, P. Kacsuk, J. Dongarra, J. Volkert (Eds.): Recent Advances in Parallel Virtual Machine and Message Passing Interface 9th European PVM/MPI Users' Group Meeting, Springer-Verlag, LNCS Vol. 2474, pp. 199-207, Linz, Austria, September 29-October 2, 2002.

Invited conference papers

1. C. Bekas, E. Kokiopoulou, I. Koutis and E. Gallopoulos. "Developing a Cluster Based MATLAB Environment for Computing Pseudospectra", GRACM Congress on Computational Mechanics, June 27-29, 2002, Patras , Greece.

Conference presentations (refereed)

1. C. Bekas and E. Gallopoulos. "Cobra: A Hybrid Method for Computing the Matrix Pseudospectrum", In Proc. Copper Mountain Conference on Iterative Methods, vol. 1, April 1998.

2. C. Bekas, O. Bertrand, E. Gallopoulos and B. Philippe. "New Continuation Methods for the Computation of the matrix Pseudospectrum", HERCMA 98, Athens University of Economics and Business.

3. C. Bekas, E. Gallopoulos and V. Simoncini. "On the Computational Effectiveness of Transfer Function Approximations to the Matrix Pseudospectrum", In Proc. Copper Mountain Conference on Iterative Methods, Vol. 1, April 2000.

4. C. Bekas, E. Gallopoulos. "Computing Pseudospectra by Fast Descent", 1st International Workshop on Parallel Matrix Algorithms and Applications, August 18-21, 2000, Neuchâtel, Switzerland.

5. C. Bekas, I. Koutis, E. Kokiopoulou, A. Sidiropoulos and E. Gallopoulos. "Parallel Methods for the Computation of Matrix Pseudospectra", 5th IMACS Conference on Iterative Methods in Scientific Computing, May 28-31, 2001.

6. I. Koutis , C. Bekas, E. Kokiopoulou and E. Gallopoulos. "Advances in the Theory and Computation of Pseudospectra", SIAM Annual Meeting, July 8-12, 2002, Philadephia, USA.

7. E. Kokiopoulou, C. Bekas and E. Gallopoulos, "Implicitly Restarted Harmonic Lanczos Bidiagonalization for the Computation of the Smallest Singular Values of Large Sparse Matrices",2nd International Workshop on Parallel Matrix Algorithms and Applications, November 9-10 2002, Neuchâtel, Switzerland.

8. C. Bekas, E. Gallopoulos and V. Simoncini, "Transfer Functions and Path Following for Computing Pseudospectra". Extended abstract in the (electronic) Proc. SIAM Conf. in Applied Linear Algebra, July 2003.

9. C. Bekas and Y. Saad. "AMLS and Spectral Schur Complements", In Proc. Copper Mountain Conference on Iterative Methods, March 2004.

10. C. Bekas, K. Petrakos and E. Gallopoulos. "Towards Computing Pseudospectra of Parameter Dependend Matrices", In Proc. Copper Mountain Conference on Iterative Methods, March 2004.

In review

1. C. Bekas, E. Gallopoulos and V. Simoncini. "Pseudospectra Computation of Large Matrices". Jan. 2004.

2. C. Bekas, E. Kokiopoulou and Y. Saad. "An Estimator for the Diagonal of a Matrix". April 2005.

Under Preparation

1. C. Bekas and Y. Saad. “Acurate Computation of Eigenvalues via Multiple-Shift AMLS”. In preparation, 2004.

2. C. Bekas and Y. Saad. “Avoiding Large Scale Eigenvalue problems in Electronic Structure Calculations”. In preparation, 2004.

3. C. Bekas, Y. Saad and J. Cheliskowsky. “Exploiting Structure in Large Scale Eigenvalue Problems in Electronic Structure Calculations”. In preparation, 2004.