

ANDREW KNYAZEV (Andrei Kniazev)

February 13, 2008

Department of Mathematical Sciences
University of Colorado at Denver and Health Sciences Center
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Education

<u>Institution</u>	<u>Date</u>	<u>Degree</u>	<u>Major</u>
Dept. Cybernetics and Comput. Sci., Moscow State University	1981	M.S.	Computer Sciences
Institute of Numerical Mathematics, Soviet Academy of Sciences	1985	Ph.D.	Numerical Math.

Professional Experience

1994-present Associate Professor of Mathematics, CU-Denver
1999-2001 Director, Center for Computational Mathematics, CU-Denver
1992-1994 Visiting Researcher, Courant Inst. of Mathematical Sciences, NYU
1983-1992 Senior Scientist, Inst. of Numer. Math. Soviet Ac. Sci., Moscow
1985-1992 Assistant Professor, Moscow Physico-Technical Institute
1986-1988 Instructor, Moscow State University, Dept. of Math. and Mechanics
1982-1985 Instructor, Moscow Institute of Engineering and Physics
1981-1983 Software Engineer, Kurchatov's Institute of Atomic Energy, Moscow

Current Research Interests: numerical linear algebra, iterative solution of large sparse linear systems and eigenproblems, bounds for eigenvalues, numerical solution of partial differential equations, parallel computing, homogenization, numerical methods in linear elasticity, domain decomposition, embedding and multigrid methods, finite element methods, spectral clustering in data mining and for text information retrieval, biclustering for DNA microarray data, spectral image segmentation and graph partitioning, registration of spectrally preconditioned images, electronic structure calculations, localization.

Grants, Fellowships, and Contracts Awarded

2007 NSF Award DMS 0728941, Analysis of Microarray Gene Expression Data, 2007-2008, \$99,973
2006 NSF DNS 0612751, Locally Optimal Preconditioned Eigenvalue Solvers, 2006-2010, Continuing Grant: \$79,958+\$83,134+\$86,450=\$249,542.
2006 CU-Denver Faculty Development Grant Award, \$2,000.
2004 NSF CNS-0420985: MRI: Collaborative Research: Acquisition of an IBM BlueGene/L Supercomputer, under the direction of Jan Mandel, Andrew Knyazev, in collaboration with CNS-0421498 Richard D. Loft, University Corporation for Atmospheric Research and CNS-0420873 H. Tufo, University of Colorado, \$ 119,332.
2004 DOE, Sandia Labs: Robust deflation analysis for preconditioned eigensolvers for large-scale modal analysis. 2004, \$ 49,995.
2004 DOE, Lawrence Livermore National Laboratory, The Center for Applied Scientific Computing: Preconditioned eigensolvers, 2004-2005. Through FusionNumerics.
2003 National Science Foundation, DMS: Preconditioned Algorithms for Large Eigenvalue Problems, Supplemental through the Approaches to Combat Terrorism program, 2003-2005, \$53,554.
2003 CU-Denver Faculty Development Award: Prototype Parallel Generalized Eigensolver, \$3,275.

2002 National Science Foundation, DMS 0208773: Preconditioned Algorithms for Large Eigenvalue Problems, 2002-2005, \$ 157,500.
2002 NSF DMS 0209311: Sixth IMACS International Symposium on Iterative Methods in Scientific Computing at CU-Denver, 2002-2003, \$ 16,555.
2002 DOE, Lawrence Livermore National Laboratory, The Center for Applied Scientific Computing: Preconditioned eigensolvers, \$53,604.
2002 DOE, Lawrence Livermore National Laboratory, The Center for Applied Scientific Computing: Sixth IMACS International Symposium on Iterative Methods in Scientific Computing at CU-Denver, 2002-2003, \$ 3,000.
2001 NASA Earth Science Enterprise's Atmospheric Chemistry Modeling and Data Analysis Program: Towards interactive three-dimensional chemical data assimilation. Joint with Boris Khattatov (The PI), Jean-Francois Lamarque, 2001-2003, \$ 177,127.
2001 CU-Denver Seed Money Award, \$700. 2000 One-semester Faculty Research Fellowship, University of Colorado at Denver.
2000 National Science Foundation, DMS MRI/SCREMS 0079719. The PI. Joint with L. Benethum, S. Billups, T. Russell, J. Mandel, 2000-2001, \$ 100,000.
1995 National Science Foundation, SCREMS. Joint with Tom Russell (the PI), Jan Mandel, Leo Franca, and Chaoqun Liu, \$ 50,000.
1995 National Science Foundation, DMS 9501507: Preconditioned Parallel Methods for Large Symmetric Eigenproblems, 1995-1998, \$ 60,000.

Honors and Awards

2006-2007 Nominee for the Researcher/Creative Artist Award for the College of Liberal Arts and Sciences at the University of Colorado at Denver.
1999-2000 Teaching Excellence Award for the College of Liberal Arts and Sciences at the University of Colorado at Denver.
1998-1999 Researcher/Creative Artist Award for the College of Liberal Arts and Sciences at the University of Colorado at Denver.
1999 CU-Denver nominee for the University of Colorado President's Faculty Excellence Award for Advancing Teaching and Learning through Technology.

BIBLIOGRAPHY—Andrew Knyazev

Publications in Refereed Journals

1982 E.G. D'yakonov and A.V. Knyazev, Group iterative method for finding lower-order eigenvalues. Moscow Univ., Ser. 15, Comput. Math. Cyber., no. 2, 32-40.
1986 V.S. Apokorina and A.V. Knyazev, BIPR-5M software code. VANT, ser. Physics and Technology of Nuclear Reactors, no. 5, Physics and Computational Methods of Nuclear Reactors, 34-35.
1986 A.V. Knyazev, Sharp a priori error estimates of the Rayleigh-Ritz method without assumptions of fixed sign or compactness. Math. Notes, 38, no. 5-6, 998-1002.
1987 A.V. Knyazev, On modified gradient methods for eigenvalue problems. Diff. Uravn., no. 4, 715-717. In Russian.
1987 A.V. Knyazev, Convergence rate estimates for iterative methods for mesh symmetric eigenvalue problem. Sov. J. Num. Anal. Math. Modelling, 2, no. 5, 371-396.
1987 A.V. Knyazev, Methods for the derivation of some estimates in a symmetric eigenvalue problem. In Comp. Processes Systems no. 5, Moscow, "Nauka", 164-173. In Russian.
1988 A.V. Knyazev and A.L. Skorokhodov, On the convergence rate of the steepest descent method in Euclidean norm. USSR Comp. Math. Math. Phys., 28, no. 5, 195-196.

- 1989 A.V. Knyazev and A.L. Skorokhodov, Preconditioned iterative methods in subspace for solving linear systems with indefinite coefficient matrices and eigenvalue problems. *Sov. J. Num. Anal. Math. Modelling*, 4, no. 4, 283-310.
- 1990 A.V. Knyazev, V.I. Lebedev, and A.L. Skorokhodov, The Temple-Lehmann methods in iterative algorithms. *Sov. J. Num. Anal. Math. Modelling*, 5, no. 4, 265-273.
- 1991 N.S. Bakhvalov and A.V. Knyazev, Methods of effective computation of homogenized properties for the composites with a periodic structure which consist of essentially different components. In *Comp. Processes Systems no.8, Moscow, "Nauka"*, 52-94. In Russian.
- 1991 A.V. Knyazev and A.L. Skorokhodov, On exact estimates of the convergence rate of the steepest ascent method in the symmetric eigenvalue problem. *Linear Algebra Applications*, v.154-156, 245-257.
- 1992 E.G. D'yakonov and A.V. Knyazev, On an iterative method for finding lower eigenvalues. *Russian J. Num. Anal. Math. Modelling*, 7, no. 6, 473-486.
- 1992 A.V. Knyazev, A parallel algorithm of subspace iterations and its implementation on a multiprocessor with ring architecture. *Russian J. Numer. Anal. Math. Modelling* 7, no. 1, 55-61.
- 1993 A.V. Knyazev and I.S. Sharapov, Variational Rayleigh quotient iteration methods for symmetric eigenvalue problem. *East-West J. of Numerical Mathematics*, 1, no. 2, 121-128.
- 1994 N.S. Bakhvalov, A.V. Knyazev, and M.E. Eglit, An inequality of the Korn type and orthogonal decompositions in spaces of matrices. *Russian Acad. Sci. Math. Doklady*, 48, no.1, 127-129.
- 1994 N.S. Bakhvalov and A.V. Knyazev, Fictitious domain methods and computation of homogenized properties of composites with a periodic structure of essentially different components. In *Numerical Methods and Applications*, Ed. Gury I. Marchuk, CRC Press, 221-276.
- 1994 A.V. Knyazev and A.L. Skorokhodov, The preconditioned gradient-type iterative methods in a subspace for partial generalized symmetric eigenvalue problem. *SIAM J. Numerical Analysis*, v. 31, 1226.
- 1996 J. Bramble, J. Pasciak, and A.V. Knyazev, A subspace preconditioning algorithm for eigenvector/eigenvalue computation. *Advances in Computational Mathematics*, 6, no. 2, 159-189.
- 1997 A.V. Knyazev, New estimates for Ritz vectors. *Math. Comp.* 66, no. 219, 985-995.
- 1998 A.V. Knyazev, Preconditioned eigensolvers - an oxymoron? *Electronic Transactions on Numerical Analysis*, 7, 104-123.
- 2000 A.V. Knyazev, Preconditioned eigensolvers. In "Templates for the Solution of Algebraic Eigenvalue Problems: A Practical Guide," Editors: Zhaojun Bai, James Demmel, Jack Dongarra, Axel Ruhe, and Henk Van der Vorst, SIAM.
- 2001 A.V. Knyazev, Toward the Optimal Preconditioned Eigensolver: Locally Optimal Block Preconditioned Conjugate Gradient Method. *SIAM Journal on Scientific Computing*, v. 23, no. 2, pp. 517-541.
- 2002 N. S. Bakhvalov, A. V. Knyazev, and R. R. Parashkevov, Extension Theorems for Stokes and Lamé equations for nearly incompressible media and their applications to numerical solution of problems with highly discontinuous coefficients. *Numerical Linear Algebra with Applications*, v. 9, no. 2, 115-139.
- 2002 A.V. Knyazev, M.E. Argentati, Principal Angles between Subspaces in an A-Based Scalar Product: Algorithms and Perturbation Estimates. *SIAM Journal on Scientific Computing*, v. 23, no. 6, 2008-2040.
- 2003 A.V. Knyazev, and O. Widlund, Lavrentiev Regularization + Ritz Approximation = Uniform Finite Element Error Estimates for Differential Equations with Rough Coefficients. *Mathematics of Computation*, 72 (2003), 17-40.
- 2003 A.V. Knyazev and K. Neymeyr, A geometric theory for preconditioned inverse iteration. III: A short and sharp convergence estimate for generalized eigenvalue problems. *Linear Algebra and*

Its Applications, 358 (2003), Issues 1-3, 95-114.

2003 A.V. Knyazev and K. Neymeyr, Efficient solution of symmetric eigenvalue problems using multigrid preconditioners in the locally optimal block conjugate gradient method. *ETNA*, 15 (2003), 38-55.

2003 A.V. Knyazev, Analysis of transmission problems on Lipschitz boundaries in stronger norms. *Journal of Numerical Mathematics*, 11, no. 3 (2003), 225-234.

2005 Stephen Billups, Andrew Knyazev and Jan Mandel, Introduction, *Applied Numerical Mathematics*, 54, 2 (2005), pp. 105-106.

2005 Jan Mandel, Lynn S. Bennethum, Mingshi Chen, Janice L. Coen, Craig C. Douglas, Leopoldo P. Franca, Craig J. Johns, Minjeong Kim, Andrew V. Knyazev, Robert Kremens, Vaibhav Kulkarni, Guan Qin, Anthony Vodacek, Jianjia Wu, Wei Zhao, and Adam Zornes, Towards a Dynamic Data Driven Application System for Wildfire Simulation, in: V.S. Sunderam et al. (Eds.): *Computational Science - Proceedings ICCS'2005*, Lecture Notes in Computer Science 3515, (2005) pp. 632-639.

2006 A. V. Knyazev and M. E. Argentati, On Proximity of Rayleigh Quotients for Different Vectors and Ritz Values Generated by Different Trial Subspaces. *Linear Algebra and Its Applications*, 415 (2006), no. 1, 82-95.

2006 A. V. Knyazev and J. Osborn, New A Priori FEM Error Estimates for Eigenvalues. *SIAM Journal on Numerical Analysis*, 43 (2006), no. 6 2647-2667.

2006 A. V. Knyazev and M. E. Argentati, Majorization for Changes in Angles Between Subspaces, Ritz values, and graph Laplacian spectra, *SIAM Journal on Matrix Analysis and Applications (SIMAX)*, 29 (2006/2007), no. 1, pp. 15-32.

2007 A. V. Knyazev, Observations on degenerate saddle point problems. *Comput. Methods Appl. Mech. Engrg.* 196, Issues 37-40, 3742-3749.

2007 A. V. Knyazev, I. Lashuk, M. E. Argentati, and E. Ovchinnikov, Block Locally Optimal Preconditioned Eigenvalue Solvers (BLOPEX) in hypre and PETSc. *SIAM Journal on Scientific Computing*, 25(5): 2224-2239.

2007 A. V. Knyazev and I. Lashuk, Steepest descent and conjugate gradient methods with variable preconditioning. *SIAM Journal on Matrix Analysis and Applications (SIMAX)*, 29(4), 1267-1280.

Accepted for Publication (to appear and in print)

2007 F. Bottin, S. Leroux, A. Knyazev, G. Zerah, Large scale ab initio calculations based on three levels of parallelization. *Comp. Material Sci.* In print: <http://dx.doi.org/10.1016/j.commatsci.2007.07.019>

2008 M. E. Argentati, A. V. Knyazev, C. C. Paige, and I. Panayotov, Bounds on changes in Ritz values for a perturbed invariant subspace of a Hermitian matrix, *SIAM Journal on Matrix Analysis and Applications (SIMAX)*. Accepted.

Submitted for Publication

2007 A. V. Knyazev, A. Jujunashvili, and M. E. Argentati, Angles Between Infinite Dimensional Subspaces with Applications to the Rayleigh-Ritz and Alternating Projectors Methods. *Journal of the American Mathematical Society*.

2008 A. V. Knyazev and M. E. Argentati, Rayleigh-Ritz majorization error bounds with applications to FEM and subspace iterations. *SIAM Journal on Matrix Analysis and Applications (SIMAX)*

2008 A. V. Knyazev and K. Neymeyr, Gradient flow approach to geometric convergence analysis of preconditioned eigensolvers. *SIAM Review (SIREV)*

In preparation

2008 A. V. Knyazev and A. Jujunashvili, Submajorization for sequences of s - and λ -numbers of operator sums.

Refereed Symposia Proceedings

1991 N.S. Bakhvalov, A.V. Knyazev, and G.M. Kobel'kov, Iterative methods for solving equations with highly varying coefficients, Proc. IV Int. Symp. Domain Decomposition Methods for Partial Differential Equations (1990), 197-205, SIAM, Philadelphia.

1991 A.V. Knyazev, A preconditioned conjugate gradient method for eigenvalue problems and its implementation in a subspace. Proc. Eigenwertaufgaben in Natur- und Ingenieurwissenschaften und ihre numerische Behandlung, Oberwolfach, 1990. International Ser. Numerical Mathematics, v. 96, 143-154. Birkhauser, Basel.

1992 A.V. Knyazev, Iterative solution of PDE with strongly varying coefficients: algebraic version. Proc. IMACS Symp. Iterative methods in linear algebra, Brussels, 1991. Iterative methods in linear algebra, R. Beauwens and P. de Groen (Editors), 85-89, Elsevier, Amsterdam.

1995 N.S. Bakhvalov and A.V. Knyazev, Preconditioned Iterative Methods in a Subspace, In Domain Decomposition Methods in Science and Engineering, Ed. D. Keyes and J. Xu, AMS, 157-162.

2007 I. Lashuk, M. E. Argentati, E. Ovchinnikov and A. V. Knyazev, Preconditioned Eigensolver LOBPCG in hypre and PETSc. Lecture Notes Comp. Sci. Engineering, Springer, 55(2007), 635-642.

Books

1984 Lebedev, V.I., Bakhvalovi, N.S., Agoshkov, V.I., Baburin, O.V., Knyazev, A.V., and Shutyaev, V.P., Parallel algorithms for solving some stationary problems of mathematical physics. Foreword by G.I. Marchuk. Dept. Num. Math. USSR Ac. Sci, Moscow. In Russian.

1986 A.V. Knyazev, Computation of eigenvalues and eigenvectors for mesh problems: algorithms and error estimates. Dept. Num. Math. USSR Ac. Sci., Moscow, 187 pp. In Russian.

Translations of Books

1988 Ikramov, Kh.D. and Knyazev, A. V. Moscow, Mir Publ., 1988. 208 pp. Translation into Russian of the book: Gregori, R. and Krishnamurti, E. Error-free calculations. Methods and applications.

1989 Ikramov, Kh.D., Knyazev, A. V., and Tyrtysnikov, E.E. Moscow, Mir Publ., 1989. Translation into Russian of the book: Horn, R.A. and Johnson, Ch. R. Matrix analysis. Cambridge Univ. Press, Cambridge, 1986.

Selected Non-Referees publications

1981 D'yakonov, E.G. and Knyazev, A.V., An iterative method for finding the smallest eigenvalues. -Preprint 26, Dept. Num. Math. USSR Ac. Sci., Moscow. In Russian.

1983 Knyazev, A.V., Methods for the simultaneous computation of several eigenvectors. -Preprint 3749/16, Atomic Energy Inst., Moscow. In Russian.

1983 Knyazev, A.V., Some two-step methods for finding the boundaries of the spectrum of a linear matrix pencil. -Preprint 3749/16, Atomic Energy Inst., Moscow. In Russian.

1983 Knyazev, A.V. and Lebedev, V.I., Estimates for convergence and analysis of the optimality of iterative methods for the simultaneous computation of several eigenvectors. -In Comp. Meth. Linear Algebra, Dept. Num. Math. USSR Ac. Sci., Moscow, 94-114. In Russian.

1984 Knyazev, A.V., Practical implementation of Bauer's iterations for neutron-physical computations. -Preprint 79, Dept. Num. Math. USSR Ac. Sci., Moscow. In Russian.

1985 Knyazev, A.V., An error estimate for the approximation by the Rayleigh-Ritz method to the invariant subspace that corresponds to nearby eigenvalues. -In Computer Arch. Num. Meth., Dept. Num. Math. USSR Ac. Sci., Moscow, 16-18. In Russian.

1985 Knyazev, A.V., Modified gradient methods and their block analogous for the problems $Mu = \lambda Lu$, $M = M$, $L = L > 0$. -In Computer Arch. Num. Meth., Dept. Num. Math. USSR Ac. Sci.,

Moscow, 19-32. In Russian.

1985 Knyazev, A.V., The Kato-Temple block algorithm for estimation of eigenvalues: substantiation and application. -In Conjugate Equations Theory Perturbations Math. Phys. Problems, Dept. Num. Math. USSR Ac. Sci., Moscow, 127-135. In Russian.

1990 Bakhvalov, N.S. and Knyazev, A.V., A new iterative algorithm for solving the fictitious fluxes method problems for elliptic eqations. -Proc.EQUADIFF 7, Praha, 1989. -Teubner-Texte zur Mathematik, b. 118, 225-227. -Leipzig: BSB Teubner.

2005 A. V. Knyazev and M. E. Argentati, Implementation of a Preconditioned Eigensolver Using Hypre, Technical report UCD-CCM 220, April 2005, at the Center for Computational Mathematics, University of Colorado at Denver.

2007 A. V. Knyazev, A. Jujunashvili, and M. E. Argentati, Angles Between Infinite Dimensional Subspaces with Applications to the Rayleigh-Ritz and Alternating Projectors Methods. <http://arxiv.org/abs/0705.1023>.

2007 A. V. Knyazev and M. E. Argentati, Rayleigh-Ritz majorization error bounds with applications to FEM and subspace iterations. <http://arxiv.org/abs/math/0701784>.

2008 A. Knyazev and K. Neymeyr, Gradient flow approach to geometric convergence analysis of preconditioned eigensolvers. <http://arxiv.org/abs/0801.3099>.

Selected Meeting Presentations

1990 4-th Symposium Domain Decomposition Methods for Partial Differential Equations, Moscow.

1990 Eigenwertaufgaben in Natur- und Ingenieurwissenschaften und ihre numerische Behandlung, Oberwolfach. *Invited speaker.*

1990 XI Householder Symposium, Tylosand, SWEDEN. *Invited speaker.*

1991 IMACS Symp. Iterative methods in linear algebra, Brussels. *Invited speaker.*

1993 XII Householder Symposium, Lake Arrowhead, USA. *Invited speaker.*

1997 Uniform wellposedness of a mixed formulation of symmetric problems with rough coefficients with application to highly nonhomogeneous linear elasticity, 8th Copper Mountain Conference on Multigrid Methods.

1997 Some history of preconditioned iterative methods for symmetric eigenvalue problems, Workshop on pre-conditioning eigenvalue problems, Argonne. *Invited speaker.*

1997 Forty years of preconditioned iterative methods for large symmetric eigenvalue problems, SIAM 45th Anniversary Meeting, *Organizer of the minisymposium Preconditioned Methods for Large Eigenproblems.*

1997 DDM for eigenproblems: eigensolvers vs. system solvers on subdomains, Tenth International Conference on Domain Decomposition Methods.

1997 A Subspace Preconditioning Algorithm for Eigenvector/Eigenvalue Computation, Sixth SIAM Conference on Applied Linear Algebra.

1998 Preconditioned eigensolvers - an oxymoron? Copper Mountain Iterative Methods Conf.

1998 Uniform Finite Element Error Estimates for Differential Equations with Rough Coefficients. Conference State of the Art in Finite Element Method, City University of Hong Kong.

1998 Iterative solution of the Lamé equations with highly discontinuous coefficients. Conference: Iterative solution methods for the elasticity equations as arising in mechanics and biomechanics IMMB'98, University of Nijmegen, The Netherlands. *Invited speaker.*

1998 Preconditioned eigensolvers. International Symposium on Theory and Algorithms for Large Scale Matrix Problems, Dalian University of Technology, Dalian, China. *Invited speaker.*

1999 MiniSymposium Very Large Eigenvalue Problems, USNCCM'99, August 4-6, 1999, UC-Boulder. *Organizer.*

1999 Domain Decomposition Methods for Eigenproblems, at the MiniSymposium Domain Decom-

position Techniques, USNCCM'99, August 4-6, 1999, UC-Boulder. *Invited speaker.*

2000 III International Workshop on Accurate Solution of Eigenvalue Problems, July 3-6, 2000, Hagen, Germany. *Invited speaker.*

2001 Conference on Preconditioned Robust Iterative Solution Methods for Problems with Singularities PRISM'2001, May 21-23, 2001, University of Nijmegen, The Netherlands. *Invited speaker.*

2001 Schnelle Loser für partielle Differentialgleichungen, 27.05. - 02.06.2001, Oberwolfach: Uniform Finite Element Error Estimates for Differential Equations with Jumps in the Coefficients. *Invited speaker.*

2002 Miniworkshop: Preconditioning in Eigenvalue Computations, 03.03. - 09.03.2002, Oberwolfach. *Organizer.*

2002 Householder Symposium XV, June 17th - 21st, 2002, Peebles, Scotland: Toward the Optimal Preconditioned Eigensolver: Locally Optimal Block Preconditioned Conjugate Gradient Method. *Invited speaker.*

2003 Sixth IMACS International Symposium on Iterative Methods in Scientific Computing CU-Denver, March 27-30, 2003. *Organizer.*

2003 11-th Copper Mountain Conference on Multigrid Methods, March 30 - APRIL 4, 2003: Implementation of a Scalable Preconditioned Eigenvalue Solver Using HyPre—jointly with M. Argentati

2003 Eighth SIAM Conference on Applied Linear Algebra, College of William and Mary, Williamsburg, Virginia, July 15-19, 2003: Is there life after the Lanczos method?

2003 Preconditioning 2003, Napa CA, OCTOBER 27-29, 2003 Scalable Preconditioned Eigenvalue Solver in HyPre—jointly with Merico E. Argentati

2003 Clustering Large Data Sets Workshop Third IEEE International Conference on Data Mining (ICDM 2003) Melbourne, Florida, November 19 - 22, 2003

2003 Theory and Numerics of Matrix Eigenvalue Problems, BIRS workshop, Banff, Alberta, Canada, November 22-27, 2003. *Invited speaker.*

2004 NSF-IC Approaches to Combat Terrorism PI Workshop Arlington, Virginia June 8, 2004 Preconditioned Algorithms for Large Eigenvalue Problems *Invited speaker.*

2004 Butcher Symposium on Genomics and Biotechnology, Broomfield, CO. November 11, 2004: Finding functional gene clusters responsive to changes in the Monomethyl Branched-Chain Fatty Acid levels—jointly with Min Han (MCDB, CU Boulder).

2005 Householder Symposium XVI, Seven Springs Resort, Champion, Pennsylvania, May 23-27, 2005: Preconditioned Eigenvalue Solvers in Electronic Structure Calculations. *Invited speaker.*

2005 Eight U.S. Congress for Computational Mechanics Austin, TX, July 25-27, 2005: Extension Theorems for Lamé Equations for Nearly Incompressible Media with Applications to Numerical Solution of Problems with Highly Discontinuous Coefficients—jointly with N. S. Bakhvalov and R. R. Parashkevov. Invited talk at the minisymposium "Homogenization: Symposium in Honor of Prof. Ivo Babuska." Analysis of Transmission Problems on Lipschitz Boundaries in Stronger Norms. Invited talk at the minisymposium "Domain Decomposition and Fictitious Domain Methods."

2006 SIAM Conference on Parallel Processing for Scientific Computing CP13 San Francisco, February 22-24, 2006: Block Locally Optimal Preconditioned Eigenvalue Solvers—jointly with Merico Argentati, Ilya Lashuk and Evgueni Ovtchinnikov.

2006 Ninth Copper Mountain Conference on Iterative Methods April 2-7, 2006: Block Locally Optimal Preconditioned Eigenvalue Solvers (BLOPEX)—jointly with Merico Argentati, Ilya Lashuk and Evgueni Ovtchinnikov. A priori error bounds for eigenvalues approximated by the Ritz values—jointly with Merico Argentati (the speaker). Steepest descent and conjugate gradient methods with variable preconditioning—jointly with Ilya Lashuk (the speaker).

2006 Fast Manifold Learning Workshop William & Mary in Williamsburg, VA, April 14-15, 2006:

Multiscale Preconditioning for Computing Eigenvalues of Graph Laplacians in Image Segmentation. *Invited speaker.*

2006 Workshop on Algorithms for Modern Massive Data Sets Stanford University and Yahoo! Research June 21-24, 2006: Multiscale Spectral Graph Partitioning and Image Segmentation.

2006 CU Energy Initiative/NREL Symposium CU Boulder, CO Oct. 3, 2006: Eigenvalue solvers for computer simulation of efficient solar cell materials— jointly with Julien Langou

2007 Stanford 50: State of the Art and Future Directions of Computational Mathematics and Numerical Computing, March 29 - 31, 2007 Stanford University: Accuracy of Ritz values from a given subspace—jointly with M. E. Argentati, C. C. Paige (the speaker), and I. Panayotov.

2007 Computational Partial Differential Equations TU Berlin, June 6, 2007: New A Priori FEM Error Estimates for Eigenvalues—jointly with John Osborn. *Invited speaker.*

2007 ICIAM 07 Zurich, Switzerland, 16-20 July 2007: Block Locally Optimal Preconditioned Eigenvalue Solvers (BLOPEX) (invited Minisymposium IC/MP/020/U/333 speaker)

2008 Tenth Copper Mountain Conference on Iterative Methods April 6-11, 2008:

- o Large scale parallel ab initio electronic structure calculations with the LOBPCG method - jointly with Zerah (the speaker), Bottin, and Le Roux.

- o Majorization-based convergence rate bounds of subspace iterations and the block Lanczos method - jointly with M. Argentati

- o Eigensolvers for analysis of microarray gene expression data

2008 Householder Symposium XVII Zeuthen, Germany June 1-6, 2008 *Invited speaker.*

2008 IACM/ECCOMAS Congress Venice, June 30th-July 5th 2008: Eigensolvers for analysis of microarray gene expression data (invited Minisymposium speaker).

2009 Oberwolfach workshop, August 9-15, 2009 Linear and Nonlinear Eigenproblems for PDEs *Organizer and invited speaker.*

For **Seminal Presentations**, see <http://math.cudenver.edu/~aknyazev/research/conf/> .

TEACHING—Andrew Knyazev

Courses Taught

Undergraduate: Calculus I, II, and III, Applied Linear Algebra, Numerical Analysis I and II, Elementary Differential Equations, Complex Variables.

Graduate: Applied Linear Algebra, Applied Analysis, Approximation Theory, Numerical Linear Algebra, Iterative Methods, Functional Analysis, Foundations of Finite Element Methods.

List of Graduate Students Supervised:

1990-1992 Ilya A. Sharapov, M.S., Inst. Numerical Math. Russian Academy of Sciences

1987-1991 Alexander L. Skorokhodov, Ph.D., Inst. Numerical Math. Russian Academy of Sciences

2000-2002 Dave Duran, M.S., CU-Denver

1999-2003 Merico E. Argentati, Ph.D., CU-Denver

2003-2005 Abram Jujunashvili, Ph.D., CU-Denver

2003-2007 Ilya Lashuk, Ph.D., CU-Denver

2006-pres Eugene Vecharynski, Ph.D., CU-Denver

2007-pres Donald McCuan, Ph.D., CU-Denver

2007-pres Peizhen Zhu, Ph.D., CU-Denver

SERVICE—Andrew Knyazev

Department of Mathematics/CCM, CU-Denver

1994-pres Development of teaching with technology and Internet-based teaching methods
1994-1995 Merit Review Committee
1995-1996 Search Committee
1994-1999 Graduate Committee (5 terms)
1996-1997 Merit Review Committee
1995-1997 Web Coordinator of the Department
1997 Math Awareness Week Organizer: Math and the Internet
1997-1999 Linear Algebra Prelim Committee
1998-2000 Coordinator of CCM Colloquia
1999-2000 Web Supervisor
2001-2002 Graduate Committee
2001-2002 Research Coordinator of the Department
2001-2002 Linear Algebra Prelim Committee
2002-2003 Analysis Prelim Committee
2003-2005 Linear Algebra Prelim Committee
2003-2005 CCM Executive Committee
2004-2005 Merit Review Committee
2004-2006 Coordinator of CCM Colloquia
2006-2007 Departmental Executive Committee

College of Liberal Arts and Sciences, CU-Denver

1999-2000 Research Awards Committee
1999-2001 Center for Computational Mathematics, Director

Campus-wide, CU-Denver and HSC

2002-2004 RTP Committee CU-Denver
2006-2007 Tenure Track Mentoring Program at UCDHSC

System-wide—University of Colorado

1999 Program Committee, CU Teaching with Technology Conference
2005-2006 President's Teaching and Learning Collaborative steering committee

Outside of University of Colorado

1997 Organizer of a Minisymposium at the SIAM annual Meeting.
1999 Organizer of a Minisymposium at the US Congress on Comp. Mechanics.
2001-2007 Editorial board of Comp. Methods in Applied Math.
2006-pres Editorial board of Int. J. Comp. Sci. and Math.
2002-2004 NERSC Computational Review Panel
2002 Organizer of the Oberwolfach Miniworkshop “Preconditioning in Eigenvalue Computations”
2003 Organizer of Sixth IMACS International Symposium on Iterative Methods in Scientific Computing, CU-Denver
2003-2005 Guest Editor of Applied Numerical Mathematics
2003-2006 Guest Editor of Linear Algebra and Its Applications
2006 Program Committee, Clustering Large High Dimensional Datasets Workshop, Hong Kong
2006 Program Committee, IMACS Conference on Iterative Methods, College Station, TX

2003,2007 Program Committee, CMAM conferences, Minsk, Belarus

1998-pres Regular referee and panelist for the NSF program in Numerical Mathematics

1995-pres Referee for SIAM Journals, Mathematics of Computation, Linear Algebra and Its Applications, etc.

1994-pres Development of public software: LOBPCG and other MATLAB codes, BLOPEX software package for *hypre* and PETSc, collaboration with ABINIT developers.

2008 Program Committee, Text Mining workshop at SIAM International Conference on Data Mining

2009 Organizer of the Oberwolfach Workshop "Linear and Nonlinear Eigenproblems for PDEs"