Curriculum Vitae

Gunnar Martinsson

Contact Information: Department of Applied Mathematics, Univ. of Colorado at Boulder, 526 UCB, Boulder, CO 80309-0526.
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Research Interests: Numerical methods for linear PDEs and integral equations. Numerical linear algebra. Applied harmonic analysis.

Randomized methods in linear algebra.

Multiscale analysis and its application to the modelling of materials and mechanical structures. Homogenization. Lattice equations.

Education: *Ph.D.* in Computational and Applied Mathematics from the University of Texas at Austin, June 2002. Thesis advisors: I. Babuška and G. Rodin.

Licentiate degree in Mathematics, Chalmers Univ. of Technology in Gothenburg, Oct. 1998. Thesis advisor: V. Thomée.

Undergraduate degree (a Swedish "Civ. Ing.") in Engineering Physics, Chalmers Univ. of Technology in Gothenburg, Dec. 1995. Thesis advisors: W. McLean (UNSW, Sydney) and S. Larsson of Chalmers Univ.

Work Experience: Assist. prof. of applied math., Univ. of Colorado at Boulder, 2005–present.

Gibbs assist. prof. of applied mathematics, Yale University, 2004–2005.

Gibbs instructor of applied mathematics, Yale University, 2002–2004.

Graduate research assistant, University of Texas at Austin, 1998–2002.

Teaching/research assistant, Chalmers University of Technology, 1993–1998.

Research assoc., Univ. of South Carolina, Jan.–Aug. 1996, Mar.–May 1997.

Military Service: Cipher analyst in the Swedish military intelligence agency, June 1991-Aug. 1992. Trained in discrete mathematics, probability theory, Russian, and linguistics.

Honors: The Sweden-America Foundation Graduate Fellowship, 2001-2002.

The University of Texas at Austin Graduate Fellowship, 1998-2001.

The Mittag-Leffler Institute's Fellowship, spring 1998.

The John Ericsson Medal, Chalmers University of Technology, 1996.

Member, Swedish team, International Physics Olympiad, Havanna, 1991.

Awards and Contracts:

NSF award "CAREER: Fast Direct Solvers for Differential and Integral Equations", sole PI, \$400 000, DMS 0748488, 2009 – 2013.

NSF award "CDI-Type I: Geometrical Image Processing with Fast Randomized Algorithms", with Francois Meyer, \$535 784, #0941476, 2009 – 2012.

NSF award "Fast direct solvers for boundary value problems", sole PI, \$151 600, DMS 0610097, 2006 – 2009.

Junior Faculty Development Award, Univ. of Colorado at Boulder, 2006.

Doctoral Students:

Adrianna Gillman. Expected date of graduation Aug. 2011.

Nathan Halko. Expected date of graduation Dec. 2011.

Dan Kaslovsky — co-advised with François Meyer in the Electrical Eng. Dept. at CU-Boulder. Expected date of graduation Dec. 2011.

Patrick Young — co-advised with Kamran Mohseni in the Aerospace Eng. Dept. at CU-Boulder. Expected date of graduation May 2010.

Book:

P.G. Martinsson, "Fast Multipole Methods". Forthcoming. Under contract with Cambridge University Press.

Refereed Publications:

All papers are available at:
http://amath.colorado.edu/faculty/martinss/main_publications.html

P.G. Martinsson and G.J. Rodin, "Boundary algebraic equations for lattice problems". *Proc. R. Soc. A*, **465**(2108), pp. 2489-2503, 2009.

L. Greengard, D. Gueyffier, P.G. Martinsson, V. Rokhlin, "Fast direct solvers for integral equations in complex three-dimensional domans". *Acta Numerica*, **18**, pp. 243–275, 2009.

P.G. Martinsson, "A fast direct solver for a class of elliptic partial differential equations". *Journal of Scientific Computation*, pp. 316-330, **38**(3), 2009.

E. Liberty, F. Woolfe, P.G. Martinsson, V. Rokhlin, and M. Tygert, "Randomized algorithms for the low-rank approximation of matrices". *Proceedings of the National Academy of Sciences*, **104**(51), 2007.

P.G. Martinsson and V. Rokhlin, "A fast direct solver for scattering problems involving elongated structures". *Journal of Computational Physics*, **221**, pp. 288–302, 2007.

P.G. Martinsson and I. Babuška, "Mechanics of Materials with Periodic Truss or Frame Micro-structures". *Archives of Rational Mechanics and Analysis*, **185**(2), pp. 201–234, 2007.

P.G. Martinsson and I. Babuška, "Homogenization of materials with periodic skeletal micro-structures". *Mathematical Models and Methods in Applied Sciences*, **17**(5), pp. 805–832, 2007.

P.G. Martinsson and V. Rokhlin, "An Accelerated Kernel-Independent Fast Multipole Method in One Dimension", *SIAM J. of Scientific Computing*, **29**(3), 2007.

P.G. Martinsson, "Rapid evaluation of electro-static interactions in two-phase dielectric media". *Journal of Computational Physics*, **211**(1), pp. 289–299, 2006.

P.G. Martinsson, V. Rokhlin, and M. Tygert, "On Interpolation and Integration in Finite-Dimensional Spaces of Bounded Functions". *Communications in Applied Mathematics and Computational Science*, 1, Jan. 2006.

P.G. Martinsson and V. Rokhlin, "A fast direct solver for boundary integral equations in two dimensions". *Journal of Computational Physics*, **205**(1), pp. 1 – 23, 2005.

P.G. Martinsson, M. Tygert and V. Rokhlin, "An $O(N \log^2 N)$ algorithm for the inversion of general Toeplitz matrices". *Computers & Mathematics with Applications*, **50**, 2005, pp. 741 – 752.

H. Cheng, Z. Gimbutas, P.G. Martinsson, V. Rokhlin, "On the compression of low rank matrices". *SIAM Journal of Scientific Computing*, **26**(4), pp. 1389-1404, 2005.

P.G. Martinsson and A.B. Movchan, "Vibrations of Lattice Structures and Phononic Bandgaps". *The Quarterly Journal of Mechanics and Applied Mathematics*, **56** , 2003, pp. 45-64.

P.G. Martinsson and G.J. Rodin, "Boundary Algebraic Equations for Lattice Problems". *IUTAM proceedings, Liverpool, 2002*

P.G. Martinsson and G. Rodin, "Asymptotic Expansions of Lattice Green's Functions". *Proceedings of the Royal Society A*, **458** , 2002, pp. 2609–2622.

E. Cornea, R. Howard and P.G. Martinsson, "Solutions near Singular Points to the Eikonal and Related First-Order Nonlinear Partial Differential Equations in Two Dimensions". *Differential and Integral Equations*, **14**, 2001, pp. 1441-1468.

Publications in Review:

N. Halko, P .G. Martinsson, J. Tropp, "Approximation of matrices via randomized sampling". Invited 75 page review article for *SIAM Review.*

P. Young and P.G. Martinsson, "A Direct Solver for the Rapid Solution of Boundary Integral Equations on Axisymmetric Surfaces in Three Dimensions". In review.

P.G. Martinsson, "Approximation of Structured Matrices via Randomized Sampling". *arXiv.org* report number 0806.2339, June 2008.

P.G. Martinsson, V. Rokhlin, and M. Tygert, "A randomized algorithm for the approximation of matrices". Yale CS research report YALEU/DCS/RR-1361. 2006.

Theses:

P.G. Martinsson, "Fast Multiscale Methods for Lattice Equations". Doctoral Thesis, TICAM, University of Texas at Austin, 2002.

P.G. Martinsson, "Discretisation of Certain Evolution Equations with Memory using Convolution Quadrature". Licentiate Thesis, Dept. of Mathematics, Chalmers University of Technology, 1998.

P.G. Martinsson, "Separation of Variables Techniques in Particle Simulations and Integral Equations". Honours Thesis, Dept. of Mathematics, University of New South Wales, 1995.

Presentations:

"Making very large-scale linear algebraic computations possible via randomization", invited plenary tutorial lecture at Neural Information Processing Systems (NIPS) Conference, Vancouver, Canada, Dec. 2009.

"Fast matrix computations via randomized sampling", Stanford applied math seminar, June 2009.

"Fast matrix computations via randomized sampling", scientific computing seminar at Uppsala University in Sweden, May 2009.

"Fast matrix computations via randomized sampling", numerical analysis seminar at the Royal Institute of Technology (KTH) in Sweden, May 2009.

"Fast matrix computations via randomized sampling", applied mathematics seminar at Chalmers University of Technology in Sweden, May 2009.

"Fast numerical methods for solving linear PDEs", Georgiatech applied math seminar, April 2009.

"Fast matrix computations via randomized sampling", special session on "Mathematics of Knowledge and Information", AMS Annual meeting, Washington DC, Jan. 2009.

"Fast matrix computations via randomized sampling", Computational Science & Engineering Seminar, Georgia Tech, Dec. 2008.

"Fast matrix computations via randomized sampling", computer science seminar, University of Toronto, April 2008.

"Fast numerical methods for solving linear PDEs", mechanical engineering colloquium, University of Pennsylvania, Jan. 2008.

"Fast numerical methods for solving linear PDEs", mathematics colloquium, University of Toronto, Jan. 2008.

"Randomized methods for the approximation of matrices", applied mathematics seminar, University of Toronto, Jan. 2008.

"Approximation of structured matrices via randomized sampling", research seminar, IPAM workshop at Lake Arrowhead, Dec. 2007.

"Fast numerical methods for solving linear PDEs", applied mathematics seminar, Caltech, Dec. 2007.

"Fast numerical methods for solving linear PDEs", IPAM seminar, Los Angeles, Dec. 2007.

"Fast numerical methods for solving linear PDEs", matrix computations seminar, Berkeley, Nov. 2007.

"Fast numerical methods for solving linear PDEs", applied mathematics seminar, Stanford University, Nov. 2007.

"Fast numerical methods for solving linear PDEs", applied mathematics seminar, Duke University, Nov. 2007.

"Randomized methods for the approximation of matrices", IPAM tutorial, Los Angeles, Sep. 2007.

"Two randomized methods for the approximation of matrices", International Congress of Industrial and Applied Mathematics, Zürich, July 2007.

"Fast direct solvers", International Congress of Industrial and Applied Mathematics, Zürich, July 2007.

"Rapid evaluation of electrostatic interactions in multi-phase media", International Congress of Industrial and Applied Mathematics, Zürich, July 2007.

"Randomized algorithms and fast direct solvers", numerical analysis seminar, Dept. of Math., University of Texas at Austin, March 2007.

"Fast numerical methods for solving linear boundary value problems", colloquium, Dept. of Math., Colorado School of Mines, Dec. 1, 2006.

Three lectures on fast numerical methods in biochemical modeling at the *European Center for Living Technology* in Venice, Italy, Oct. 2006.

"Fast numerical methods for solving linear boundary value problems", colloquium, Dept. of Applied Math., Univ. of Colo. at Boulder, Sep. 8, 2006.

"Fast multipole methods", computational math. seminar, Dept. of Applied Math., Univ. of Colorado at Boulder, Sep. 8, 2006.

"Fast direct solvers for integral equations", 8th U.S. National Congress on Computational Mechanics, Austin, TX, July 2005.

"Multiscale modeling of materials with periodic micro-structures", 8th U.S. National Congress on Computational Mechanics, Austin, TX, July 2005.

"Bandgap phenomena in materials with periodic skeletal micro-structures", 8th U.S. National Congress on Computational Mechanics, Austin, TX, July 2005.

"Fast direct solvers for boundary value problems", applied math. seminar, University of Colorado at Boulder, March 2005.

"Fast direct solvers for boundary value problems", applied math. seminar, University of Minnesota, Feb. 2005.

"Fast direct solvers for boundary value problems", applied math. seminar, Rutgers University, Feb. 2005.

"Fast direct solvers for boundary value problems", University of Colorado at Boulder, March 2005.

"Modeling of Lattice Materials Using Greens Functions", Amer. Soc. of Mech. Eng. Congress, Nov. 2004.

"A fast direct solver for boundary integral equations in two dimensions". Similar presentations on this theme given at: SIAM annual meeting, Jul 2004; Intern. Assoc. of Boundary Element Methods conference, May 2004; ICES seminar, UT-Austin, May 2004; Lund university, March 2004; Max-Planck Institute, Leipzig, Feb. 2004; Christian-Albrechts-Universität zu Kiel, Feb. 2004; Chalmers University of Techn., Feb. 2004; University of Uppsala, Feb. 2004; Royal Institute of Techn., Stockholm, Feb. 2004; Yale applied mathematics seminar, Dec. 2003.

"Conditioning of numerical computations and fast algorithms", Mathematics seminar, Univ. of Karlstad, Feb. 2004.

"Boundary methods for the fast solution of discrete potential problems", workshop on boundary equation methods at Oberwolfach, Germany, Dec. 2002.

"Fast numerical techniques for problems involving micro-structure", applied mathematics seminar, Yale, Nov. 2002.

"Model selection in problems involving multiple length-scales"; Penn. State Univ., Jan. 2002; UNC-Chapel Hill, Feb. 2002; UC-Irvine, Feb. 2002.

"Hierarchical Homogenization", shared keynote addess with Gregory Rodin, U.S. Assoc. Comput. Mech. 6th National Congress, Dearborn, MI, Aug. 2001.

"Lattice Materials can Filter Mechanical Waves", U.S. Assoc. Comput. Mech. 6th National Congress, Dearborn, MI, Aug. 2001.

"Shape from Shading", Texas Institute for Computational and Applied Mathematics seminar, University of Texas at Austin, May 2000.

"Computational Methods for Lattice Block Materials", Society for Engineering Science 36th Annual Meeting, Austin, TX, Oct. 1999.

"Discretisation of Certain Evolution Equations with Memory using Convolution Quadrature", Texas Institute for Computational and Applied Mathematics seminar, University of Texas at Austin, Nov. 1998.

"Shape from Shading", Applied Mathematics seminar, Chalmers University of Technology, Oct. 1996.

Courses Taught:

"Differential Equations with Linear Algebra" (APPM2360) at the University of Colorado at Boulder. Large-section undergraduate class (140 students per section). Taught in Spring 2008 and Spring 2009. Course coordinator supervising 12 TAs and 3 co-instructors.

"Applied Analysis I and II" (APPM5440 and APPM5450) at the University of Colorado at Boulder. Year-long mandatory class for applied mathematics graduate students. Redeveloped curriculum in 2005. Taught multiple times.

"Linear Algebra with Applications" (MATH222a) at Yale University. Mid-level undergraduate class.

"Multivariate Calculus" (MATH120b) at Yale University. Entry-level calculus class.

Service Activities:

Referee for: *International Journal of Solids and Structures*, *Proceedings of the Royal Society A*, *Applied and Computational Harmonic Analysis*, *Journal of Computational Physics*, *Mathematics of Computations*, *Computer Methods in Applied Mechanics and Engineering*, *etc.*

Faculty opponent at the Ph.D. defense of Johan Englund, June 16, 2006, Lund's University.

External reader of the Ph.D. dissertation of Andreas Glaser, May 2007, Yale University.

External reader of the Ph.D. dissertation of Michael O'Neil, Aug. 2007, Yale University.

Dissertation committee member for: Jisun Lim (2007), Christopher Kurcz (2007), Matthew Reynolds (2009).