Konstantin Rybnikov
Curriculum Vitae

1 January 2005

Department of Mathematical Sciences
University of Massachusetts Lowell
Lowell, MA 01854
Tel. 978-934-2426 (voice mail) FAX: (978)-934-3053,
E-mail: krybniko@cs.uml.edu http://faculty.uml.edu/krybnikov

Research Interests:

Discrete and Convex Geometry,
Computational Geometry and Topology,
Geometry of Numbers,
Graph Theory,
Graph Rigidity & Flexibility with A View towards Molecular Modeling,
Stochastic Geometry,
Statistics.

Undergraduate Education:

• September 1988 – June 1993 Moscow State University (a.k.a. University of Moscow)
Faculty of Mathematics and Mechanics
Specialty: *Mathematics/Applied Mathematics* Major: *Discrete Mathematics*
Degree conferred: *Diploma (≈ M.Sc.) with Honors, 1993* (supervisor: S. Ryshkov)

Graduate Education:

• November 1993 – August 1995 Moscow State University
Graduate School of the Faculty of Mathematics and Mechanics
Program: *Ph.D. in Mathematics* (supervisor: S. Ryshkov)
Major Concentration: *Discrete Mathematics and Theoretical Computer Science*
Minor Concentration: *Geometry and Topology*
Passed all degree requirements but dissertation
• January 1998 – May 1998
Fields Institute for Research in Mathematical Sciences, University of Toronto
Visiting Graduate Student in the program *Complexity Theory*
• January 1999 – June 1999
Fields Institute for Research in Mathematical Sciences, University of Toronto
Visiting Graduate Student in the program *Probability and its Applications*
• September 1995 – October 1999 Queen's University (ON, Canada)
Department of Mathematics and Statistics
Degree conferred: *Ph.D. in Mathematics (*supervisor: R. Erdahl)

Postdoctoral Experience:

• January 2000 – December 2001 Cornell University
NSERC Postdoctoral Fellow in the Department of Mathematics

Academic/Professional Appointments:

• August 2002 – present UMASS Lowell

Assistant Professor (tenure-track) in the Department of Mathematical Sciences

Courses taught: Calculus I and II (honors), Discrete Structures II, Differential Equations, Abstract Algebra, Directed Studies in Computational Geometry (Rigidity and Flexibility of Graphs), Directed Studies in Algebraic and Computational Topology.

• January 2000 – August 2002 Cornell University, Ithaca, NY

Assistant Professor Department of Mathematics

Courses taught: Classical Geometries (upper-year undergraduate), Calculus, Euclidean and Spherical Geometry, Combinatorics (upper-year undergraduate), Linear Algebra. Applied Algebra, Abstract Algebra (upper-year undergraduate).

Directed NSF **R**esearch **E**xperience for **U**ndergraduates project Geometry of Numbers.

• September 1995 – August 1999 Queen's University, Kingston, Ontario

Teaching Assistant in the Department of Mathematics and Statistics

Courses: Calculus, Linear Algebra, Differential Equations and Computer Methods, Applied Mathematics, Control Theory

• September 1995 - December 1999 Queen's University

Research Assistant

• July 1995 – August 1995 Moscow State University

Examiner, Admission Committee

• January 1995 – August 1995

Research Assistant of Prof. S. Ryshkov in Moscow State University and Steklov Mathematical Institute

• November 1993 – December 1994 Moscow state University

Research Assistant

• September 1993 – May 1994 Moscow state University

Teaching Assistant in the Faculty of Mathematics and Mechanics for courses *Theory of Lattice Points, Discrete and Visual Geometry.* Teaching course *Introduction to the Theory of Lattice Points* for half a semester.

Grants:

NSF personal "incubation" grant, 2004-2005 *Studies in Geometry: Convexity, Polyhedra, Rigidity, and Point Lattices*

NSF/DAPRA grant, 2003-2005 *CARGO: Verification of Properties of Geometric Structures and Reconstruction of Geometric Objects from Partial Information* (joint with K. Daniels and D. Klain)

Mathematical Sciences Research Institute (Berkeley) grant-fellowship (2003) in Discrete and Computational Geometry for the Fall of 2003 MSRI Discrete and Computational Geometry Program.

Grant (2003-2004) for professor-student research and learning collaboration. Teaching Center and Faculty of Science, UMASS Lowell.

Supervision of Student Research:

Current Supervision:
• Karthik Ramanathan, M.Sc. student (UMASS Lowell Computer Science). Area: C++ implementation of algorithms verifying rigidity of graphs and other structures modeling macromolecules.
• Kishor Bhat, B.Sc/M.Sc. student (UMASS Lowell Mathematical Sciences) and ISET scholar. Area: algebraic topology and its connections to computational geometry; convex hull construction and verification.

Past Supervision:
• Summer of 2003. I supervised Bradford Jones (Computer Science honors student, UMASS Amherst '2006) in his work on implementation of geometric algorithms, developed by Dan Klain and myself for the CARGO project funded by NSF. Supported in part by my start-up grant.
• Summer of 2002. I advised Joseph Palin (Mathematics, Cornell '2003) in the areas of Discrete Geometry and Geometry of Numbers. Funded by Cornell VIGRE grant from the Division of Mathematical Sciences of NSF.
• Summer of 2001. Director of Cornell's NSF *Research Experience for Undergraduates* project Geometry of Numbers. See http://matlab.cit.cornell.edu/~upsilon

Students: Sarah Crown (Bryn Mawr and Havertfort), Michael Greene (Harvard), Jody Radowitz (North Central), Kirsten Wickelgren (Harvard). Kirsten received the NSF graduate scholarship (I wrote one of the two official recommendations) for PhD studies in Princeton, but took it to Stanford, where she started her Ph.D. in September of 2004. Michael worked for NSA (upon my advice and recommendation letter) in the summer of 2002 and is now a Ph.D. student (I wrote one of the official recommendations). Sarah and Jody are now Ph.D. students in the University of Michigan specializing in algebraic combinatorics.

Other Academic Activities:

• Fall 2004 UMASS Lowell
Memeber of the UMASS Lowell Research Task Force representing the Department of Mathematical Sciences.
• September 2002 – present UMASS Lowell
Department's Library Liason, member of the Department Hiring Committee and interdepartmental Committee on Computational Mathematics Sc.D. Program

I ordered more than 60 books; After this round of ordering the UMASS collection of books in discrete, convex, and computational geometry is the third best in Massachusetts, after Harvard's and MIT's.
• September 2000 – December 2000 Cornell University
Member of the Putnam Team Committee, Department of Mathematics
• September 1998 – December 1998 Queen's University
Graduate Student Representative on the Tenure, Renewal, and Promotions Committee, Department of Mathematics and Statistics
• November 1997 – March 1998 Queen's University
Graduate Student Representative on the Appointments Committee, Department of Mathematics & Statistics

Awards:

Name of the Scholarship	Eligibility
Distinct Stipend for maintaining A average 1988–1993	institutional (Moscow State U.)
R. Samuel McLaughlin Fellowship 1995	institutional (Queen's)
E. G. Bauman Fellowship 1996	institutional (Queen's)
Queen's Graduate Fellowship 1997	institutional (Queen's)
Fields Institute Graduate Scholarship 1998	national (Canada)
Ontario Graduate Scholarship 1998	provincial (Ontario)
Fields Institute Graduate Scholarship 1999	national (Canada)
Ontario Graduate Scholarship 1999	provincial (Ontario)
National Science and Engineering Research Council Postdoctoral Fellowship 1999	national (Canada)
Pacific Institute for Mathematical Sciences Postdoctoral Fellowship 1999 (declined)	national (Canada)
Best Thesis of the Division of Sciences of the Graduate School of Queen's in 1999	institutional (Queen's)
Mathematical Sciences Research Institute Postdoctoral Fellowship in Discrete and Computational Geometry 2003	international

Publications

K. A. Rybnikov, T. Zaslavsky, *Cycle Criteria for Balance in Abelian Gain Graphs with Application to Piecewise-Linear Geometry* (200X). To appear in *Discrete and Computational Geometry.* Available as math.CO/0210052 on arXiv.org.

R.M. Erdahl, A. Ordine, and K. Rybnikov, *Perfect Delaunay polytopes* To appear in *2003 Voronoi Conference on Analytic Number Theory and Spatial Tesselations, Inst. Math. National Academy of Sciences, Kiev, Ukraine, 200X.* Earlier edition is available as math.NT/0408122 on arXiv.org.

K. A. Rybnikov, T. Zaslavsky, *Cycle and Circle Tests of Balance in Gain Graphs: Forbidden Minors and Their Groups* (200X). To appear in *J. Graph Theory.* Also available as math.CO/0209316 on arXiv.org.

R. M. Erdahl, K. Rybnikov, Voronoi's Hypothesis on Perfect Forms and L-types. *Rendiconti del Circolo Matematiko di Palermo*, Serie II, Tomo LII, part I (2002), 279-296. A longer version available as *math.MG/0112098* on arXiv.org.

R. M. Erdahl, K. Rybnikov, New Infinite Series of Perfect Quadratic Forms and Big Delaunay Simplexes in $\mathbb{Z}^n$. *Proc. of Steklov Institute of Math.*. no. 4 **239** (2002), 159-167. Also available as *math.MG/0112098* on arXiv.org.

M. Menshikov, K. Rybnikov, and S. Volkov, Loss of Tension in an Infinite Membrane with Holes Distributed by Poisson Law. *Advances in Applied Probability,* **34** , No. 2 (2002), 292-312. Also available at http://faculty.uml.edu/krybnikov/PS/mrv.ps

R. Connelly, K. Rybnikov, and S. Volkov, Percolation of the Loss of Tension in an Infinite Triangular Lattice, *Journal of Statistical Physics,* **105**, No. 1/2, (2001), 145-173. Also available at http://faculty.uml.edu/krybnikov/PS/crv.ps

R. M. Erdahl, K. A. Rybnikov, and S. S. Ryshkov, On traces of d-stresses in the skeletons of lower dimensions of homology d-manifolds, *Europ. J. Combin.* **22**, No. 6, (2001), 801-820. Also available at http://faculty.uml.edu/krybnikov/PS/erryry.ps

K. Rybnikov, *Polyhedral Partitions and Stresses*, Ph.D. Thesis, Queen's University, Kingston, Ontario (1999), Available at http://faculty.uml.edu/krybnikov/PS/disser.ps.gz. *Awarded "Best thesis of the Division of Sciences in 1999 in Queen's."*

K. Rybnikov, Stresses and liftings of cell-complexes, *Discrete and Computational Geometry*, **21**, No. 4, (1999), 481–517. On WWW http://faculty.uml.edu/krybnikov/PS/rybnikov.ps.gz with Corrigendum in LaTeX at http://faculty.uml.edu/krybnikov/ .

S. S. Ryshkov, K. A. Rybnikov Jr., The theory of quality translation with applications to tilings. *European J. Combin.*, vol. **18**, No. 4, (1997), 431-445.

S. S. Ryshkov, K. A. Rybnikov Jr., Generatrissa: the Problems of Maxwell and Voronoi. *Doklady Mathematics*, vol. **54**, No. 1, (1996), 614-617.

K. A. Rybnikov Jr., On the density of three-dimensional compacta. *Doklady Mathematics*, vol. **48**, No. 1, (1994), 110-113.

Preprints and papers in preparation

D. Klain, K. Rybnikov, K. Daniels, B. Jones, C. Neacsu. *Algorithms for statistical estimation of Euler characteristic and surface area from point cloud data.* (2004) Submitted.

K. Rybnikov, *Graph homomorphisms and the ring of labeled graphs.* (200X) In preparation.

K. Rybnikov, K. Ramanathan *C++ Library for Analyzing Rigidity of Structures. Description and Manual.* (200X) In preparation.

K. Rybnikov, *Generalized convexity and face-structure of locally convex hypersurfaces* (200X) In preparation.

K. Rybnikov, *Locally convex hypersurfaces in hyperbolic spaces* (200X) In preparation.

R.M. Erdahl, K. Rybnikov, and A. Ordine, *Many infinite series of perfect Delaunay polytopes* (200x) In preparation.

K. Rybnikov, *On locally convex PL-manifolds and fast verification of convexity* (200X) Preprint math.MG/0309370 on arXiv.org.

K. Rybnikov, *Fast verification of convexity of piecewise-linear surfaces* (200X) Preprint cs.CG/0309041 on arXiv.org.

R. Erdahl, K. Rybnikov, *Supertopes* (200x). Out-of-date preliminary version available as http://faculty.uml.edu/krybnikov/PDF/Supertopes.pdf .

Conference contributions and invited talks

General Convexity Theory. Invited talk at the *2004 Winter Meeting of Canadian Mathematical Society.* Montreal. Dec. 11-13, 2004.

Rigidity of Proteins and Probabilistic Approach to Graph Rigidity *and* Computational Difficulties in Rigorous Verification of Rigidity. *NSF-sponsored Workshop on Rigidity and Flexibility of Proteins* BIRS, Banff, Alberta. July 2004.

Verification of Properties of Geometric Structures and Reconstruction of Geometric Objects from Partial Information (joint with K. Daniels). *CARGO meeting organized by NSF and DARPA.* Monona Terrace, Madison, WI, May 12, 2004.

Testing for Convexity. *MIT Combinatorics Seminar.* Apr. 2, 2004.

Local Convexity: Is it Strong Enough to Guarantee Global Convexity? *Geometry Seminar, Penn State.* 25 Feb. 2003

When is a locally convex surface convex? Theorems and algorithms for PL-manifolds. *GASC Seminar*, *Northeastern University*, Jan. 26, 2004.

Local vs. Global Convexity of PL-surfaces in Classical Geometries. *Conference on Discrete and Combinatorial Geometry* Nov. 17, 2003. (this invited talk was given right after the conference, due to a health problem)

On Locally Convex PL-manifolds and Fast Verification of Convexity. *Kolmogorov Centennial Conference, Moscow,* June 18, 2003. Page 236 in the abstracts of talks.

On the State of Voronoi's Conjecture on Parallelohedra. Invited Talk at the Convex Geometry Session, *AMS meeting in Northeastern University*, Boston, October 6, 2002.

Voronoi's Conjecture and Local-to-Global Constructions in Discrete Geometry. Invited Talk at the *Janos Bolyai Bicentennial Symposium, Budapest,* July 2002.

Geometry of Positive Quadratic Forms over Integers, Geometry of Inhomogeneous Quadratic Forms over Integers, Invited talk *at Combinatorics and Number Theory Seminar*, *Binghamton University,* April 30, 2002.

Gain graphs and their applications to convex polyhedra and splines, Invited Colloquium talk, *Department of Mathematics, Vanderbilt University,* Nashville, TN, April 1, 2002.
Gain graphs and their applications in geometry, Invited Colloquium talk, *Department of Mathematics and Statistics, University of Calgary,* February 26

Maxwell's correspondence and gain graphs, Invited Talk at *the Courant Institute Geometry Seminar*, February 19, 2002

Gain Graphs and their Applications to Geometry of PL-surfaces and Splines, Invited Colloquium talk, *Department of Mathematics, University of South Carolina, Columbia, SC,* February 12. 2002

Gain Graphs and its Application, Invited talk *at the University of Binghamton*, April 17, 2001

Commensurability of Lattice Tilings and Delaunay Tilings for Positive Semidefinite Forms, *AMS meeting at the University of Kanzas, Lawrence,* April 2, 2001

Voronoi reduction methods with perfect forms and L-types, *LSU Conference on Quadratic Forms*, *Baton Rouge,* LA, March 26-March 30, 2001

Big Holes in Lattices, Talk at the Discrete Geometry Session, *National AMS Meeting, New Orleans,* LA, January 13, 2001.

Partial Generalization of Maxwell's correspondence to spatial graphs, *AMS meeting in Toronto*, Spetember 23, 2000.

Bootstrap percolation of iterated convex hulls. Invited talk at the *Mathematical Physics Seminar, University of Virginia.* September 18, 2000.

Lifting cell-complexes, Invited talk at the *European Conference on Discrete and Algorithmic Geometry*, *Anogia,* Crete, Greece, August 18-25, 2000.

Bootstrap Percolation of Convex Defects. Invited talk at the *Lowell AMS meeting*, *Lowell,* MA, April 2, 2000.

Tension percolation on a triangular lattice, Delaunay simplexes of large relative volume. Invited talks at the conference *Lattices, Polytopes, and Tilings*, *Oberwolfach Mathematical Institute*, Germany, February 27 – March 4, 2000.

The loss of tension in an infinite membrane with holes distributed by a Poisson law. Talk at *Montreal Winter Meeting of CMS*, *Montreal,* Quebec, December 12, 1999.

Stresses in skeletons of homology manifolds. Invited talk at *Kingston Winter Meeting of CMS*, *Kingston,* Ontario, December 1998.

Oriented Matroids from Liftings and Stresses. Invited talk at *Saint John Meeting of CMS*, *Saint John*, New Brunswick, June 1998.

The theory of quality translation with applications to tilings. Invited talk at Conference *Affine Geometry of Convex Sets*, *Dalhousie University,* Halifax, Nova Scotia, July 1996.

On the density of three-dimensional normal spaces, Talk at the *II National Conference on Discrete Mathematics*, Moscow, January 1993.

Conference Proceedings

S. S. Ryshkov, K. A. Rybnikov, On a decomposition as projection of a convex polyhedron, in *Functional Spaces, the Theory of Approximations, Non-Linear Analysis - Proceedings of the International Conference in Honor of 90-th Birthday of S. M. Nikolskii, Abstracts of Lectures*, p. 238, Russian Academy of Science, Moscow, 1995.

S. S. Ryshkov, K. A. Rybnikov, On the generatrise of a plane decomposition by convex polygons, in *Proceedings of National Workshop on Stochastic Methods in Geometry and Analysis*, Abrau-Durso, 25.08.1994-2.10.1994, (Russian) pp. 99-100, TVP (Theory Probab. Appl.) Publishing House, Moscow, 1994.

References

Robert Connelly (Cornell, Ithaca, USA)
e-mail: connelly@math.cornell.edu phone: (607)-255-4301
Robert Erdahl (Queen's, Kingston, Canada)
e-mail: erdahlr@post.queensu.ca phone: (613)-549-2281, (613)-533-2428
Sergei Ryshkov (Moscow State University and Steklov Institute of Mathematics, Russia)
e-mail: ryshkov@mi.ras.ru phone: +7-(095)-336-5864
Walter Whiteley (York, Toronto, Canada)
e-mail: whiteley@mathstat.yorku.ca phone: (416)-736-5250 (ext. 33971)
Thomas Zaslavsky (SUNY, Binghampton)
e-mail: zaslav@math.binghamton.edu phone: (607)-777-2201

Personal Information:

Citizenship: Russian, Canadian. Permanent Resident of the US.