

# YURIY MILEYKO

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## Research Interests

Topological Data Analysis, Mathematical Biology, Applied and Computational Topology/Geometry

## Education

Ph.D., Mathematical Sciences, New Jersey Institute of Technology and Rutgers the State University of New Jersey. 05/2005  
Advisor: Denis Blackmore. Thesis: *Theory and algorithms for swept manifold intersections.*

Specialist, Applied Mathematics, National Taras Shevchenko University of Kyiv 06/2001

B.S., Applied Mathematics, National Taras Shevchenko University of Kyiv 07/2000

## Professional Experience

Visiting Assistant Professor, Department of Mathematics, Duke University 09/2009 – present

Postdoctoral Fellow, School of Biology, Georgia Institute of Technology 03/2008 – 08/2009  
Advisor: Joshua Weitz

Research Associate, Department of Computer Science, Duke University 05/2005 – 02/2008  
Advisors: Herbert Edelsbrunner and John Harer

Research Assistant, NSF/DARPA CARGO Grant CCR-0310619, Accuracy and Stability of Computational Representations of Swept Volume Operations. Advisor: Denis Blackmore 07/2003 – 05/2005

## Teaching Experience

### Lead Instructor

Multivariable Calculus for Economists (MATH 102), Undergraduate Duke, Spring 2012

Multivariable Calculus for Economists (MATH 102), Undergraduate Duke, Fall 2011

Differential Equations (MATH 2403), Undergraduate GA Tech, Fall 2008

Differential Equations (MATH 222), Undergraduate NJIT, Spring 2004

Special course: Linear Algebra, Real and Complex Analysis, and Numerical Methods for Qualifying Exams, Graduate NJIT, Fall 2003

Calculus III (MATH 213B), Undergraduate NJIT, Summer 2003

### Co-Instructor

Geometry, Random Matrices, and Statistical Inference, Graduate SAMSI, Spring 2007

### Guest Lecturer

Modeling Bio Systems (Math 214S), Undergraduate, 1 lecture, Duke, Fall 2009

Theoretical Ecology, Advanced Undergraduate and Graduate, 1 lecture GA Tech, Fall 2007

Topology (MATH 205), Undergraduate, 4 lectures Duke, Fall 2006

Advanced Calculus I (MATH 545), Advanced Undergraduate and Graduate, 6 lectures NJIT, Fall 2003

## Teaching Assistant

Calculus II (MATH 112), Undergraduate  
Calculus I (MATH 111), Undergraduate

NJIT, Spring 2003  
NJIT, Fall 2002

## Publications

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\* indicates alphabetical author list.

### Published/In Press

- Y. MILEYKO, H. EDELSBRUNNER, C. A. PRICE, AND J. S. WEITZ. *Hierarchical ordering of reticular networks*, PLoS ONE, in press
- Y. MILEYKO, S. MUKHERJEE, J. HARER. *Probability measures on the space of persistence diagrams*, Inverse Problems, Vol. 27, 124007, 2011
- C. A. PRICE, O. SYMONOVA, Y. MILEYKO, T. HILLEY, AND J. S. WEITZ. *LEAF GUI: segmenting and analyzing the structure of leaf veins and areoles*, Plant Physiology, Vol. 155, No. 1, pp. 236–245, 2011
- Y. MILEYKO AND J. S. WEITZ. *Bifurcation Analysis of Gene Regulatory Circuits Subject to Copy Number Variation*, SIAM Journal on Applied Dynamical Systems, Volume 9, Issue 3, pp. 799–826, 2010
- \* D. COHEN-STEINER, H. EDELSBRUNNER, J. HARER, AND Y. MILEYKO. *Lipschitz functions have  $L_p$ -stable persistence*, Foundations of Computational Mathematics Journal, Vol. 10, No. 2, pp. 127–139, 2010
- A. IYER-PASCUZZI, O. SYMONOVA, Y. MILEYKO, Y. HAO, H. BELCHER, J. HARER, J.S. WEITZ AND P. BENFEY. *Imaging and Analysis Platform for Automatic Phenotyping and Classification of Plant Root Systems*, Plant Physiology, Vol. 152, No. 3, pp. 1148–1157, 2010
- Y. MILEYKO, R. I. JOH, AND J. S. WEITZ. *Small-scale copy number variation and large-scale changes in gene expression*, Proceedings of the National Academy of Sciences USA, Vol 105, pp. 16659-16664, 2008
- J. WEITZ, Y. MILEYKO, R. I. JOH, AND E. VOIT. *Collective Decision Making in Bacterial Viruses*, Biophysical Journal, Vol. 95, pp. 2673–2680, 2008
- \* M.-L. DEQUEANT, S. AHNERT, H. EDELSBRUNNER, T. M. A. FINK, E. F. GLYNN, G. HATTEM, A. KUDLICKI, Y. MILEYKO, J. MORTON, A. R. MUSHEGIAN, L. PACHTER, M. ROWICKA, A. SHIU, B. STURMFELS, OLIVIER POURQUIE. *Comparison of Pattern Detection Methods in Microarray Time Series of the Segmentation Clock*, PLoS ONE 3(8): e2856, 2008. doi:10.1371/journal.pone.0002856
- \* D. ATTALI, H. EDELSBRUNNER AND Y.MILEYKO. *Weak Witnesses for Delaunay Triangulations of Sub-manifolds*, SPM '07: Proceedings of the 2007 ACM symposium on Solid and physical modeling, pp. 143–150, 2007
- D. ATTALI, H. EDELSBRUNNER, J. HARER, AND Y. MILEYKO. *Alpha-Beta Witness Complexes*, In “Proc. 11th Workshop Alg. Data Struct.”, Springer-Verlag, Lecture Notes in Computer Science, Vol. 4619, pp. 386–397, 2007
- \* D. BLACKMORE AND Y. MILEYKO. *Computational Differential Topology*, Applied General Topology, Volume 8, No. 1, pp. 35-92, 2007
- \* D. BLACKMORE, M.C. LEU, Y. MILEYKO, W.C. REGLI, AND W. SUN. *Computational topology and swept volumes*, DIMACS Series in Discrete Mathematics and Theoretical Computer Science, Volume 67, pp. 53-78, 2005

### Publications in Ukrainian

B.V. RUBLEV AND Y. MILEYKO. *Construction of the smallest enclosing ellipse and the smallest enclosing ellipsoid for a finite set of points in  $m$ -dimensional Euclidean space*, In "Proc. 5th Ukrainian Intl. Conf. 'UkrOBRAZ' ", Kyiv, 2000, pp.79-82

B.V. RUBLEV, Y.I. PETUNIN AND Y. MILEYKO. *Geometric properties of the smallest enclosing ellipse and some related questions*, Kyiv University Publisher, Kyiv, 2000, 74p.

B.V. RUBLEV, O.I. MOLODTSOV AND Y. MILEYKO. *Fast method for constructing Fisher linear discriminant functions*, Kyiv University Bulletin, Vol. 4, pp. 217-222, 1999

B.V. RUBLEV AND Y. MILEYKO. *Construction of the smallest enclosing ellipsoid for elementary polyhedra*, Kyiv University Bulletin, Vol. 3, pp. 236-242, 1999

B.V. RUBLEV AND Y. MILEYKO. *Modification of the recursive procedure for solving linear programming problem*, Kyiv University Bulletin, Vol. 2, pp. 273-277, 1999

Y.I. PETUNIN, B.V. RUBLEV AND Y. MILEYKO. *An optimal algorithm for constructing the smallest enclosing ellipse in a finite number of steps*, Kyiv University Bulletin, Vol. 3, pp. 87-95, 1998

## In Review

T. GALKOVSKIY, Y. MILEYKO, A. BUCKSCH, B. MOORE, O. SYMONOVA, C. A. PRICE, C. N. TOPP, A. S. IYER-PASCUZZI, P. R. ZUREK, S. FANG, J. HARER, P. N. BENFEY, AND J. S. WEITZ. *GiA Roots: Software for High Throughput Analysis of Plant Root System Architecture*, in review

## Manuscripts and work in preparation

K. TURNER, Y. MILEYKO, S. MUKHERJEE, AND J. HARER. *Fréchet mean and variance for distributions of persistence diagrams*, in prep.

Y. MILEYKO, J. HARER. *Defining Shape Skeleta via Persistent Homology*, in prep.

Y. MILEYKO, J. HARER, AND C. TOPP. *Automatic Clasification of Plant Root Types*, in prep.

\* H. EDELSBRUNNER, J. HARER, AND Y. MILEYKO. *An experimental study of alpha-beta witness complexes*, Manuscript, Duke Univ., Durham, North Carolina, 2006

Y. MILEYKO. *Theory and algorithms for swept manifold intersections*, Ph.D. Thesis, Newark, NJ, May 2005

## Invited Talks

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*Topological summaries for biological data: the Why, the What, and the How*, Department of Mathematics Colloquium, Feb. 27, 2012, Oregon State University, Corvallis, OR

*Hierarchical ordering of reticular networks*,

Physical Mathematics Seminar, March 20, 2012, MIT, Cambridge, MA

Mathematical and Computational Biology seminar, Feb. 15, 2012, UC Berkeley, Berkeley, CA

*Probability measures on the space of persistence diagrams*,

Workshop on Computational Topology, November 8, 2011, Fields Institute, Toronto, Canada

SIAM Conference on Applied Algebraic Geometry, October 6, 2011, NC State University, Raleigh, NC

Duke Data Seminar, September 29, 2011, Duke University, Durham, NC

*Estimating homology of high-dimensional point clouds*, Vision, Information and Statistical Signal Theories and Applications group seminar, Sep. 18, 2009, NC State University, Raleigh, NC

*Computational Aspects of Persistent Homology*, NSF/CBMS Regional Conference on Algebraic Topology in Applied Mathematics, Aug. 3-7, 2009, Cleveland State University, Cleveland, OH

*Defining Hierarchical Order within Reticular Networks*, Workshop on Data Analysis using Computational Topology and Geometric Statistics, March 8-13, 2009, BIRS, Banff, Alberta, Canada

*Nonlinear Effect of Copy Number Variation on Gene Expression*,

Systems Biology Seminar, Feb. 3, 2010, Center for Systems Biology, Duke University, Durham, NC

Nonlinear Science Seminar, March 3, 2009, School of Physics, Georgia Tech, Atlanta, GA

Math. Biology & Ecology Seminar, Feb. 25, 2009, School of Mathematics, Georgia Tech, Atlanta, GA

*Persistent Homology of Leaf Networks*, SIAM Conference on Discrete Mathematics, June 16-19, 2008, Burlington, VT

*$L_p$ -Stability of Persistence of Lipschitz Functions*,

Workshop on Geometric and Topological Approaches to Data Analysis, Oct. 8-12, 2007, Chicago, IL

Geometry and Topology Seminar, Oct. 22, 2007, School of Mathematics, Georgia Tech, Atlanta, GA

*$L_p$ -Stability of Total Persistence*, Workshop on Discrete Geometry and Topology in Low Dimensions, April 1-6, 2007, BIRS, Banff, Alberta, Canada

*Persistence Based Measures of Gene Periodicity*, Workshop on Application of Topology in Science and Engineering, Sep. 18-22, 2006, Berkeley, CA

*Witness Complexes at Work*, DARPA meeting on Topological Data Analysis, May 8-10, 2006, Santa Barbara, CA

## Contributed Talks

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*Nonlinear Effect of Copy Number Variation on Gene Expression*, International Conference on Mathematical Biology, July 27-30, 2009, University of British Columbia, Vancouver, Canada

*Alpha-Beta Witness Complexes*, Workshop on Algorithms and Data Structures (WADS), August 15-17, 2007, Halifax, Nova Scotia, Canada

*Construction of Witness Complexes*, IMA New Directions Short Course in Computational Topology, July 6-16, 2004, Institute for Mathematics and its Applications, Minneapolis, MN

*Differential Equation Approach to Manifold Intersections*, SIAM Conference on Geometric Design and Computing, Nov. 10-13, 2003, Seattle, Washington

*Differential Equation Approach to Manifold Intersections*, Departmental Summer Project Presentation, June 2003, NJIT, NJ

*Problems associated with the Probability Hypothesis Density Function approach for multi-target tracking*, 7th PIMS-IMA Industrial Problem Solving Workshop, May 25-29, 2003, University of Calgary, Calgary, Alberta, Canada

*Solar Car Racing Strategy*, 6th PIMS-IMA Graduate Mathematics Modelling Camp, May 17-22, 2003, BIRS, Banff, Alberta, Canada

*Construction of the smallest enclosing ellipse and the smallest enclosing ellipsoid for a finite set of points in  $m$ -dimensional euclidean space*, 5th Ukrainian International Conference 'UkrOBRAZ', October 2000, Kyiv, Ukraine

*An algorithm for constructing the smallest enclosing ellipsoid for a finite set of points in  $\mathbb{R}^n$* , 8th International Conference in honor of M. Kravchuk, May 2000, Kyiv, Ukraine

## Poster Presentations

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*Assessing Periodicity in Gene Expression Data*, 2008 Workshop for Young Researchers in Mathematical Biology, Sep. 2-5, 2008, Mathematical Biosciences Institute, Columbus, Ohio

*A Probabilistic Perspective on Persistence Homologies*, NIPS Workshop, Topology Learning: New Challenges At the Crossing of Machine Learning, December 7, 2007, Whistler, British Columbia, Canada

*Homological Characterization of Tangential Intersections*, NSF/DARPA Computational and Algorithmic Representations of Geometric Objects (CARGO) Program Review, May 11-12, 2005, Santa Fe, NM

*Swept Manifolds Intersections*, Frontiers in Applied and Computational Mathematics, May 21-22, 2004, New Jersey Institute of Technology, Newark, NJ

*Swept Surfaces Intersections*, The 15th Annual Saint Joseph's University Sigma Xi Student Research Symposium, April 23, 2004, Philadelphia, Pennsylvania

*Homology Criteria for Transverse Intersections*, NSF/DARPA Computational and Algorithmic Representations of Geometric Objects (CARGO) Program Review, May 18-20, 2004, Madison, WI

## Professional Service

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Scientific Committee, Second Semester Emphasis on Geometry and Random Matrices, SAMSI 2006-07 Program on High Dimensional Inference and Random Matrices

Video and multimedia presentation program committee, 22<sup>nd</sup> Annual ACM Symposium on Computational Geometry.

Reviewer for Journal of Computational Geometry.

Reviewer for Foundations of Computational Mathematics journal.

Reviewer for Computer-Aided Design journal.

Reviewer for ACM Symposium on Computational Geometry (SoCG).

Reviewer for ACM-SIAM Symposium on Discrete Algorithms (SoDA).

Reviewer for Discrete and Computational Geometry journal.

## Awards and Honors

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College of Science & Liberal Arts Award: Exceptional Graduate Student (April 28, 2004)

NJIT, Department of Mathematical Sciences Graduate Assistantship (Fall 2001–May 2005)

Third prize, Ukrainian Mathematical Students Olympiad (1997)

## Non-academic Experience

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Advanced Programmer/Engineer (C++, Visual C++, Win API, Networking), KP VTI 10/2000 – 08/2001

Programmer (Visual C++), Debet Plus 10/1998 – 09/2000

## Computer Skills

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Expert knowledge of C++ and C. Advanced knowledge of Networking, Web Programming, MATLAB/Octave, LaTeX. Considerable knowledge of various basic software.

## **Professional Memberships**

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American Mathematical Society

Association for Computing Machinery

Society for Industrial and Applied Mathematics

Society for Mathematical Biology

## **Press**

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*Study Reveals How Multiple Viruses Can Determine Bacterial Cell Fate*, Georgia Tech Press Release, Sep. 15, 2008

*Virology: Collective calm*, Research Highlights, Nature 454, 256, Jul. 17, 2008