
Nisheeth K. Vishnoi

École Polytechnique Fédérale de Lausanne (EPFL)

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Research Interests

Algorithms, Optimization, Complexity, Spectral Methods, Dynamical Systems, Markov Chains, Evolution, Theoretical Machine Learning

Education

- 1999-2004 **Ph.D. in Algorithms, Combinatorics and Optimization**, *Georgia Institute of Technology*, Atlanta. Advised by Richard J. Lipton
- 1995–1999 **B. Tech. in Comp. Sc. and Engg.**, *IIT Bombay*, Mumbai

Recognition

- 2016 IIT Bombay Young Alumni Achievers Award
- 2013-16 Associate, International Center for Theoretical Sciences, TIFR, Bangalore, India
- 2012-15 Adjunct Faculty, IIT Kanpur, India
- Fall 2014 Invited participant, Algorithmic Spectral Graph Theory, Simons Institute for the Theory of Computing, Berkeley
- Spring 2014 Invited participant, Evolutionary Biology and the Theory of Computing, Simons Institute for the Theory of Computing, Berkeley
- 2011 Indian National Science Academy Young Scientist Medal
- 2006 IBM Research Pat Goldberg Memorial Award for 2005
- 2005 Best Paper Award at IEEE Foundations of Computer Science (FOCS)

Professional Activities

- Co-Organizer Dagstuhl Seminar on "Evolution and Computing", 2016
- Chair EPFL Research Day 2015 on "The Computational Universe"
- Co-Organizer Breakthroughs in Theoretical Computer Science 2011, 2013
- Co-Organizer The 2011 School of Approximability, Bangalore
- Co-Chair FSTTCS 2013
- PC Member ITCS 2016, 2015, SODA 2014, STOC 2011, FSTTCS 2009 and 2011

Mentees and Students

- '14– Damian Straszak, EPFL
- '14–'15 Gaganpreet Singh, IIT Kanpur
- '14–'15 Shubham Modi, IIT Kanpur
- '12 Rohit Gurjar, IIT Kanpur
- '11–'12 Sushant Sachdeva, Princeton University
- '11–'12 Jugal Garg, IIT Bombay
- '11 Piyush Srivastava, UC Berkeley
- '11 Rajesh Balagam, Indian Inst. of Sciences
- '09 Madhur Tulsiani, UC Berkeley, Now at TTI Chicago
- '09 Rajsekar Manokaran, Princeton University
- '09–'11 Anand Louis, Georgia Institute of Technology
- '07–'08 David Steurer, Princeton University
- '07–'11 Lorenzo Orecchia, UC Berkeley

Recent Invited Talks

- Jan. 2016 Dagstuhl workshop on Evolution and Computing
- Dec. 2015 Simons reunion workshop on Spectral Graph Theory, Berkeley
- Dec. 2015 London School of Economics
- Dec. 2015 Computer Sc. and Engg. IIT Delhi
- Nov. 2015 Hausdorff Research Institute for Mathematics
- Dec. 2015 6th Cargese workshop on Combinatorial Optimization
- July 2015 Princeton University
- July 2015 Simons reunion workshop on Evolutionary Biology, Berkeley
- July 2015 22nd International Symposium on Mathematical Programming, Pittsburgh
- Apr. 2015 Bellairs workshop on Combinatorial Optimization, Barbados
- Apr. 2015 Columbia University, New York
- Apr. 2015 Institute for Advanced Study, Princeton
- Dec. 2014 Computer Sc. and Engg., IIT Kanpur
- Dec. 2014 Computer Sc. and Engg., IIT Madras
- Dec. 2014 Simons Institute, Berkeley
- Dec. 2014 Workshop on Approximation Algorithms and Hardness of Approximation, Banff
- July 2014 Workshop on Flexible Network Design, Lugano
- May 2014 Computer Sc. and Engg., IIT Kanpur
- April 2014 ARC Theory Day, Georgia Tech
- April 2014 ICERM, Brown
- Mar. 2014 Ideas and Problems Seminar, Simons Institute, Berkeley
- Feb. 2014 Population Genetics and Evolution, ICTS
- Jan. 2014 ELC Workshop in Inapproximability, Tokyo

Jan. 2014 RIMS, Kyoto
Jan. 2014 Dept. of Mathematics, Indian Institute of Science
Jan. 2014 Chennai Mathematical Institute
Dec. 2013 Breakthroughs in Theoretical Computer Science, IIT Guwahati
Nov. 2013 International Center for Theoretical Sciences Colloquium, Bangalore
Oct. 2013 FOCS 2013 Workshop on Zeros of Polynomials and their Applications to Theory
Sep. 2013 School of Natural Science Colloquium, TIFR
Sep. 2013 JNCASR, Bangalore
Mar. 2013 TCS+, Online seminars
Dec. 2012 Computer Sc. and Engg., IIT Kanpur
Oct. 2012 Dept. of Computer Sc., University of Chicago
Oct. 2012 Computer Sc. and Engg., IIT Bombay
Aug. 2012 Computer Sc. and Engg., IIT Kanpur
June 2012 Algorithmic Frontiers, EPFL, Lausanne
May 2012 Computer Science Department. Columbia University
May 2012 Institute for Advanced Study, Princeton
May 2012 Microsoft Research, New England
Apr. 2012 Algorithms and Randomness Center, Georgia Institute of Technology, Atlanta
Jan. 2012 Workshop on Introduction to Graph and Geometric Algorithms, NIT Surathkal
Dec. 2011 Approximation algorithms and the hardness of approximation, Banff
Oct. 2011 Computer Sc. and Engg., IIT Delhi
Sep. 2011 EECS, UC Berkeley
May 2011 Weizmann Institute of Sciences, Rehovot
Feb. 2011 EECS, UC Berkeley
Feb. 2011 Microsoft Research, New England
Feb. 2011 Microsoft Research, Silicon Valley Center
Jan. 2011 IEOR, Columbia University
Jan. 2011 Institut Henri Poincaré, Paris
May 2010 Computer Sc. and Engg., IIT Kanpur
June 2010 KTH, Stockholm
May 2010 Hausdorff Center, Bonn
Mar. 2010 EECS, UC Berkeley
Mar. 2010 Computer Science, Rutgers University, New Brunswick
Mar. 2010 Institute for Advanced Study, Princeton
Mar. 2010 Annual Symposium on Logic, Washington D.C.

Monographs and Expository

A Mini-Course on Convex Optimization (with a view toward designing fast algorithms). Nisheeth K. Vishnoi.

Zeros of Polynomials and their Applications to Theory: A Primer. Nisheeth K. Vishnoi.

Evolution without sex, drugs and Boolean functions. Nisheeth K. Vishnoi.

Faster Algorithms via Approximation Theory. Sushant Sachdeva, Nisheeth K. Vishnoi. *Foundations and Trends in Theoretical Computer Science*, 2014.

“ $Lx = b$ ”: Laplacian Solvers and their Algorithmic Applications. Nisheeth K. Vishnoi. *Foundations and Trends in Theoretical Computer Science*, 2013.

Publications

Complexity, Dynamical Systems On the computational complexity of limit cycles in dynamical systems. Christos H. Papadimitriou, Nisheeth K. Vishnoi. *In Innovations in Theoretical Computer Science (ITCS)*, 2016.

Optimization, Dynamical Systems On a natural dynamics for linear programming. Damian Straszak, Nisheeth K. Vishnoi. *In Innovations in Theoretical Computer Science (ITCS)*, 2016.

Optimization, Dynamical Systems Natural algorithms for flow problems. Damian Straszak, Nisheeth K. Vishnoi. *In ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2016.

Evolution, Markov Chains, Dynamical Systems Evolutionary dynamics on finite populations mix rapidly. Ioannis Panageas, Piyush Srivastava, Nisheeth K. Vishnoi. *In ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2016.

Complexity, Metric Geometry The unique games conjecture, integrality gap for cut problems and the embeddability of negative type metrics into ℓ_1 . Subhash A. Khot, Nisheeth K. Vishnoi. *In Journal of ACM (JACM)*, Vol. 62, Issue 1, Article No. 8., 2015

Evolution, Markov Chains The speed of evolution. Nisheeth K. Vishnoi. *In ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2015.

Complexity Almost polynomial factor hardness for Closest Vector Problem with Preprocessing. Subhash A. Khot, Preyas Papat, Nisheeth K. Vishnoi. *In SIAM J. Computing*, 43(3), 1184-1205, 2014.

Algorithms, Optimization Entropy, optimization and counting. Mohit Singh, Nisheeth K. Vishnoi. *In 46th ACM Symposium on Theory of Computing (STOC)*, 2014.

- Evolution, Dynamical Systems* Making evolution rigorous- the error threshold. Nisheeth K. Vishnoi. In *Innovations in Theoretical Computer Science (ITCS)*, 2013.
- Algorithms, Economics* Towards polynomial simplex-like algorithms for market equilibria. Jugal Garg, Ruta Mehta, Milind Sohoni, Nisheeth K. Vishnoi. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2013.
- Algorithms* A permanent approach to the traveling salesman problem. Nisheeth K. Vishnoi. In *IEEE Foundations of Computer Science (FOCS)*, 2012.
- Evolution, Markov chains* A finite population model of molecular evolution: Theory and computation. Narendra M. Dixit, Piyush Srivastava, Nisheeth K. Vishnoi. In *Journal of Computational Biology*, 19(10): pp. 1176–1202, 2012.
- Evolution* Stochastic Simulations suggest that HIV-1 survives close to its error threshold. Kushal Tripathi, Rajesh Balagam, Nisheeth K. Vishnoi, Narendra M. Dixit. In *PLoS Computational Biology*, 8(9): e1002684, 2012.
- Machine Learning* A local spectral method for graphs: with applications to improving graph partitions and exploring data graphs locally. Michael W. Mahoney, Lorenzo Orecchia, Nisheeth K. Vishnoi. In *Journal of Machine Learning (JMLR)*, Vol 13., pp. 2339–2365, 2012.
- Algorithms* Approximating the exponential, the Lanczos method and an $\tilde{O}(m)$ -time spectral algorithm for balanced separator. Lorenzo Orecchia, Sushant Sachdeva, Nisheeth K. Vishnoi. In *44th ACM Symposium on Theory of Computing (STOC)*, 2012.
- Complexity* $2^{\log^{1-\epsilon} n}$ hardness for closest vector problem with preprocessing. Subhash Khot, Preyas Popat, Nisheeth K. Vishnoi. In *44th ACM Symposium on Theory of Computing (STOC)*, 2012.
- Complexity* Hardness of approximating the closest vector problem with pre-processing. Misha Alekhnovich, Subhash Khot, Guy Kindler, Nisheeth K. Vishnoi In *Computational Complexity*, 2012.
- Computer Vision* Biased normalized cuts. Subhransu Maji, Nisheeth K. Vishnoi, Jitendra Malik In *24th IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2011.
- Algorithms* Towards a SDP-based approach to spectral methods: A nearly-linear time algorithm for graph partitioning and sparsification. Lorenzo Orecchia, Nisheeth K. Vishnoi. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, January 2011.
- Algorithms, Complexity* On LP-based approximability for strict CSPs. Amit Kumar, Rajsekar Manokaran, Madhur Tulsiani, Nisheeth K. Vishnoi. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, January 2011.

- Algorithms, Complexity* Algorithms and hardness for subspace approximation. Amit Deshpande, Madhur Tulsiani, Nisheeth K. Vishnoi. *In ACM-SIAM Symposium on Discrete Algorithms (SODA), January 2011.*
- Algorithms* Improved algorithm for degree bounded survivable network design problem. Anand Louis, Nisheeth K. Vishnoi. *In the 12th Scandinavian Symposium and Workshops on Algorithm Theory, pp. 408–419, 2010.*
- Learning, Combinatorics* On the Fourier spectrum of symmetric Boolean functions. Mihail N. Kolountzakis, Richard J. Lipton, Evangelos Markakis, Aranyak Mehta, Nisheeth K. Vishnoi. *In Combinatorica, Vol. 29, No. 3, pp. 363–387, 2009.*
- Complexity* Deterministically testing sparse polynomial identities of unbounded degree. Markus Blaser, Moritz Hardt, Richard J. Lipton, Nisheeth K. Vishnoi. *In Information Processing Letters 109(3): pp. 187–192, 2009.*
- Complexity* Unique games on expanding constraint graphs are easy. Sanjeev Arora, Subhash A. Khot, Alexandra Kolla, David Steurer, Madhur Tulsiani, Nisheeth K. Vishnoi. *In 40th ACM Symposium on Theory of Computing (STOC), pp. 21–28, 2008. Invited for publication in Theory of Computing.*
- Algorithms* On partitioning graphs via single commodity flows. Lorenzo Orecchia, Leonard Schulman, Umesh V. Vazirani, Nisheeth K. Vishnoi. *In the 40th ACM Symposium on Theory of Computing (STOC), pp. 461–470, 2008. Invited for publication in Theory of Computing.*
- High Performance Computing* The impact of noise on the scaling of collectives: The nearest neighbor model. Nisheeth K. Vishnoi. *In the 14th International Conference on High Performance Computing, pp. 476–487, 2007.*
- Complexity, Metric Geometry* Integrality gaps for sparsest cut and minimum linear arrangement problems. Nikhil R. Devanur, Subhash Khot, Rishi Saket, Nisheeth K. Vishnoi. *In the 38th ACM Symposium on Theory of Computing (STOC), pp. 537–546, 2006.*
- Complexity, Metric Geometry* The unique games conjecture, integrality gap for cut problems and the embeddability of negative type metrics into ℓ_1 . Subhash A. Khot, Nisheeth K. Vishnoi. *In the 46th Annual IEEE Symposium on Foundations of Computer Science (FOCS), pp. 53–62, 2005.*
- Complexity* Hardness of approximating the closest vector problem with pre-processing. Misha Alekhnovich, Subhash A. Khot, Guy Kindler, Nisheeth K. Vishnoi. *In the 46th Annual IEEE Symposium on Foundations of Computer Science (FOCS), pp. 216–225, 2005.*
- Algorithms, Networks* Caching with expiration times for internet applications. Parikshit Gopalan, Howard J. Karloff, Aranyak Mehta, Milena Mihail, Nisheeth K. Vishnoi. *In Internet Mathematics 2(2), 2005. Electronic Journal.*

- High Performance Computing* The impact of noise on the scaling of collectives: A theoretical approach. Saurabh Agarwal, Rahul Garg, Nisheeth K. Vishnoi. *In the International Conference on High Performance Computing*, pp. 280–289, 2005.
- Learning, Combinatorics* On the fourier spectrum of symmetric boolean functions with applications to learning symmetric juntas. Richard J. Lipton, Evangelos Markakis, Aranyak Mehta, Nisheeth K. Vishnoi. *In the 20th IEEE Conference on Computational Complexity (CCC)*, pp. 112–119, 2005.
- Complexity* On the complexity of Hilbert’s 17th problem. Nikhil R. Devanur, Richard J. Lipton, Nisheeth K. Vishnoi. *In FSTTCS 2004: Foundations of Software Technology and Theoretical Computer Science, 24th International Conference, Chennai, India*, pp. 237–249, 2004.
- Complexity* Deterministic identity testing for multivariate polynomials. Richard J. Lipton, Nisheeth K. Vishnoi. *In 14th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pp. 756–760, 2003.
- Markov Chains* Non uniform random walks. Nisheeth K. Vishnoi. *In Discrete Mathematics and Theoretical Computer Science, vol. AC (2003)*, pp. 345–358, *Discrete Random Walks 2003*. Editors: Cyril Banderier and Christian Krattenthaler.
- Algorithms, Networks* Who’s *The Weakest Link?* Nikhil R. Devanur, Richard J. Lipton, Nisheeth K. Vishnoi. *In the 2nd Symposium on Stochastic Algorithms, Foundations and Applications*, pp. 108–116, 2003.
- Algorithms, Networks* Caching with expiration times. Parikshit Gopalan, Howard Karloff, Aranyak Mehta, Milena Mihail, Nisheeth K. Vishnoi. *In the 13th ACM-SIAM ACM Symposium on Discrete Algorithms (SODA)*, pp. 540–547, 2002.
- Algorithms, Networks* On generating graphs with prescribed degree sequences for complex network modeling applications. Milena Mihail, Nisheeth K. Vishnoi. *In Approximation and Randomized Algorithms for Communication Networks*, 2002.
- Combinatorics* An algebraic proof of Alon’s Combinatorial Nullstellensatz. Nisheeth K. Vishnoi. *In Congressus Numerantium, vol. 152*, 89–91, 2001.