

Vladimir Kolmogorov

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Research interests Computer vision, machine learning, graph algorithms, combinatorial optimization, stereo, segmentation, MRF models.

Education

- ◇ **Cornell University**, Ithaca, NY (1999-2003).
PhD in Computer Science (2003).
MS in Computer Science (2002).
Supervisor: Prof. Ramin Zabih.
GPA: 4.16 / 4.
- ◇ **Moscow Institute of Physics and Technology**, Russia (1994-1999).
MS in Applied Mathematics and Physics.
GPA: 5.0 / 5.

Professional experience

- ◇ **Institute of Science and Technology (IST)**, Austria (September 2011 - current).
Assistant Professor.
- ◇ **University College London**, UK (October 2005 - August 2011). Lecturer.
- ◇ **Microsoft Research**, Cambridge, UK (December 2009 - June 2010). Consultant.
- ◇ **Microsoft Research**, Cambridge, UK (December 2008 - June 2009). Visiting Researcher.
- ◇ **Microsoft Research**, Cambridge, UK (July 2007 - June 2008). Visiting Researcher.
- ◇ **Microsoft Research**, Cambridge, UK (February - December 2006). Visiting Researcher.
- ◇ **Microsoft Research**, Cambridge, UK (October 2003 - October 2005).
Associate Researcher. Supervisor: Prof. Andrew Blake.
- ◇ **Siemens Corporate Research, Imaging Department**, Princeton, NJ
(Summer 2000, Summer 2001). Intern. Supervisor: Dr. Yuri Boykov.
- ◇ **Weill Medical College, Department of Radiology**, New York, NY (Spring 2001).
Visiting Research Assistant. Supervisor: Prof. Yi Wang.

Publications

Book Chapters

- ◇ Y. Boykov, V. Kolmogorov. “Basic Graph Cut Algorithms”. In *Advances in Markov Random Fields for Vision and Image Processing*, MIT Press, to appear.
- ◇ C. Rother, V. Kolmogorov, Y. Boykov, A. Blake. “Interactive Foreground Extraction using graph cut”. In *Advances in Markov Random Fields for Vision and Image Processing*, MIT Press, to appear.
- ◇ A. Criminisi, G. Cross, A. Blake, V. Kolmogorov. “Bilayer Segmentation of Video”. In *Advances in Markov Random Fields for Vision and Image Processing*, MIT Press, to appear.
- ◇ R. Szeliski, R. Zabih, D. Scharstein, O. Veksler, V. Kolmogorov, A. Agarwala, M. Tappen, C. Rother. “A Comparative Study of Energy Minimization Methods for MRFs”. In *Advances in Markov Random Fields for Vision and Image Processing*, MIT Press, to appear.
- ◇ M. Pawan Kumar, V. Kolmogorov, P. H. S. Torr. “Analyzing Convex Relaxations for MAP Estimation”. In *Advances in Markov Random Fields for Vision and Image Processing*, MIT Press, to appear.

- ◇ S. Vicente, V. Kolmogorov, C. Rother. “Graph-cut Based Image Segmentation with Connectivity Priors”. In *Advances in Markov Random Fields for Vision and Image Processing*, MIT Press, to appear.
- ◇ V. Kolmogorov, R. Zabih. “Graph Cut Algorithms for Binocular Stereo with Occlusions”. In *Mathematical Models in Computer Vision: The Handbook*, Springer-Verlag, 2005.

Journals

- ◇ V. Kolmogorov. “A Faster Algorithm for Computing the Principal Sequence of Partitions of a Graph”. *Algorithmica*, 56(4):394-412, April 2010.
- ◇ V. Kolmogorov and A. Shioura. “New Algorithms for Convex Cost Tension Problem with Application to Computer Vision”. *Discrete Optimization (DO)*, 6(4):378-393, November 2009.
- ◇ V. Kolmogorov. “Blossom V: A new implementation of a minimum cost perfect matching algorithm”. *Mathematical Programming Computation (MPC)*, 1(1):43-67, July 2009.
- ◇ M. Pawan Kumar, V. Kolmogorov and P. H. S. Torr. “An Analysis of Convex Relaxations for MAP Estimation of Discrete MRFs”. *Journal of Machine Learning Research (JMLR)*, 10:71-106, January 2009.
- ◇ R. Szeliski, R. Zabih, D. Scharstein, O. Veksler, V. Kolmogorov, A. Agarwala, M. Tapten, C. Rother. “A Comparative Study of Energy Minimization Methods for Markov Random Fields with Smoothness-Based Priors”. *IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI)*, 30(6):1068-1080, June 2008.
- ◇ V. Kolmogorov, C. Rother. “Minimizing Nonsubmodular Functions with Graph Cuts - A Review”. *IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI)*, 29(7):1274-1279, July 2007.
- ◇ V. Kolmogorov. “Convergent Tree-reweighted Message Passing for Energy Minimization”. *IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI)*, 28(10):1568-1583, October 2006.
- ◇ V. Kolmogorov, A. Criminisi, A. Blake, G. Cross, C. Rother. “Probabilistic Fusion of Stereo with Color and Contrast for Bilayer Segmentation”. *IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI)*, 28(9):1480-1492, September 2006.
- ◇ C. Rother, V. Kolmogorov, A. Blake. “GrabCut - Interactive Foreground Extraction using Iterated Graph Cuts”. *ACM Transactions on Graphics (SIGGRAPH)*, August 2004.
- ◇ Y. Boykov, V. Kolmogorov. “An Experimental Comparison of Min-Cut/Max-Flow Algorithms for Energy Minimization in Vision”. *IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI)*, 26(9):1124-1137, September 2004.
- ◇ V. Kolmogorov, R. Zabih. “What Energy Functions can be Minimized via Graph Cuts?” *IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI)*, Special Issue on Energy Minimization Methods in Computer Vision and Pattern Recognition, 26(2):147-159, February 2004.

Conferences

- ◇ A. Huber, V. Kolmogorov. “Towards Minimizing k-Submodular Functions”. In *2nd International Symposium on Combinatorial Optimization*, Athens, Greece, April 2012.
- ◇ V. Kolmogorov, S. Zivny. “The complexity of conservative valued CSPs”. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, Kyoto, Japan, January 2012.
- ◇ V. Kolmogorov. “Unifying L^1 -convex and bisubmodular functions”. In *International Symposium on Mathematical Foundations of Computer Science (MFCS)*, Warsaw, Poland, August 2011.
- ◇ D. Tarlow, D. Batra, P. Kohli, V. Kolmogorov. “Dynamic Tree Block Coordinate Ascent”. In *International Conference on Machine Learning (ICML)*, Bellevue, USA, June 2011.
- ◇ A. Osokin, D. Vetrov, V. Kolmogorov. “Submodular Decomposition Framework for Inference in Associative Markov Networks with Global Constraints”. In *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, Colorado Springs, USA, June 2011.

- ◇ S. Vicente, C. Rother, V. Kolmogorov. “Object Cosegmentation”. In *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, Colorado Springs, USA, June 2011.
- ◇ Y. Bachrach, V. Kolmogorov, P. Kohli. “Team Coverage Games”. In *International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, Taipei, Taiwan, May 2011.
- ◇ V. Kolmogorov. “Generalized roof duality and bisubmodular functions”. In *Neural Information Processing Systems Conference (NIPS)*, Vancouver, Canada, December 2010.
- ◇ S. Vicente, V. Kolmogorov, C. Rother. “Cosegmentation Revisited: Models and Optimization”. In *European Conference on Computer Vision (ECCV)*, Crete, Greece, September 2010.
- ◇ O. Woodford, C. Rother, V. Kolmogorov. “A Global Perspective on MAP Inference for Low-Level Vision”. In *IEEE International Conference on Computer Vision (ICCV)*, Kyoto, Japan, October 2009.
- ◇ S. Vicente, V. Kolmogorov, C. Rother. “Joint optimization of segmentation and appearance models”. In *IEEE International Conference on Computer Vision (ICCV)*, Kyoto, Japan, October 2009.
- ◇ L. Torresani, V. Kolmogorov, C. Rother. “Feature Correspondence via Graph Matching: Models and Global Optimization”. In *European Conference on Computer Vision (ECCV)*, Marseille, France, October 2008.
- ◇ P. Kohli, A. Shekhovtsov, C. Rother, V. Kolmogorov and P. H. S. Torr. “On Partial Optimality in Multi-label MRFs”. In *International Conference on Machine Learning (ICML)*, Helsinki, Finland, July 2008.
- ◇ S. Vicente, V. Kolmogorov and C. Rother. “Graph cut based image segmentation with connectivity priors”. In *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, Anchorage, USA, June 2008.
- ◇ M. Pawan Kumar, V. Kolmogorov and P. H. S. Torr. “An Analysis of Convex Relaxations for MAP Estimation”. In *Advances in Neural Information Processing Systems (NIPS)*, Vancouver, Canada, December 2007 (**honorable mention, outstanding student paper award**).
- ◇ V. Kolmogorov, Y. Boykov, C. Rother. “Applications of parametric maxflow in computer vision”. In *IEEE International Conference on Computer Vision (ICCV)*, Rio de Janeiro, Brazil, October 2007.
- ◇ C. Rother, V. Kolmogorov, V. Lempitsky, M. Szummer. “Optimizing binary MRFs via extended roof duality”. In *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, Minneapolis, USA, June 2007.
- ◇ C. Rother, V. Kolmogorov, T. Minka, A. Blake. “Cosegmentation of Image Pairs by Histogram Matching - Incorporating a Global Constraint into MRFs”. In *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, New York, USA, June 2006.
- ◇ A. Criminisi, G. Cross, A. Blake, V. Kolmogorov. “Bilayer Segmentation of Live Video”. In *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, New York, USA, June 2006.
- ◇ Y. Boykov, V. Kolmogorov, D. Cremers, A. Delong. “An integral solution to surface evolution PDEs via Geo-Cuts”. In *European Conference on Computer Vision (ECCV)*, Graz, Austria, May 2006.
- ◇ V. Kolmogorov, C. Rother. “Comparison of energy minimization algorithms for highly connected graphs”. In *European Conference on Computer Vision (ECCV)*, Graz, Austria, May 2006.
- ◇ R. Szeliski, R. Zabih, D. Scharstein, O. Veksler, V. Kolmogorov, A. Agarwala, M. Tappen, C. Rother. “Comparative Study of Energy Minimization Methods for Markov Random Fields”. In *European Conference on Computer Vision (ECCV)*, Graz, Austria, May 2006.
- ◇ V. Kolmogorov, Y. Boykov. “What Metrics Can Be Approximated by Geo-Cuts, or Global Optimization of Length/Area and Flux”. In *IEEE International Conference on Computer Vision (ICCV)*, Beijing, China, October 2005.

- ◇ V. Kolmogorov, M. Wainwright. “On the Optimality of Tree-reweighted Max-product Message Passing”. In *Conference on Uncertainty in Artificial Intelligence (UAI)*, Edinburgh, Scotland, July 2005.
- ◇ V. Kolmogorov, A. Criminisi, A. Blake, G. Cross, C. Rother. “Bi-layer Segmentation of Binocular Stereo Video”. In *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, San Diego, CA, June 2005 (**best paper honorable mention award**).
- ◇ C. Rother, S. Kumar, V. Kolmogorov, A. Blake. “Digital Tapestry”. In *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, San Diego, CA, June 2005.
- ◇ R. Zabih, V. Kolmogorov. “Spatially Coherent Clustering with Graph Cuts”. In *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, Washington, DC, June 2004.
- ◇ J. Kim, V. Kolmogorov, R. Zabih. “Visual Correspondence Using Energy Minimization and Mutual Information”. In *IEEE International Conference on Computer Vision (ICCV)*, Nice, France, October 2003.
- ◇ Y. Boykov, V. Kolmogorov. “Computing Geodesics and Minimal Surfaces via Graph Cuts”. In *IEEE International Conference on Computer Vision (ICCV)*, Nice, France, October 2003.
- ◇ V. Kolmogorov, R. Zabih. “Multi-camera Scene Reconstruction via Graph Cuts”. In *European Conference on Computer Vision (ECCV)*, Copenhagen, Denmark, May 2002 (**best paper award**).
- ◇ V. Kolmogorov, R. Zabih. “What Energy Functions can be Minimized via Graph Cuts?” In *European Conference on Computer Vision (ECCV)*, Copenhagen, Denmark, May 2002 (**best paper award**).
- ◇ V. Kolmogorov, R. Zabih. “Computing Visual Correspondence with Occlusions using Graph Cuts”. In *IEEE International Conference on Computer Vision (ICCV)*, Vancouver, Canada, July 2001.

Workshops

- ◇ V. Kolmogorov. “Convergent Tree-reweighted Message Passing for Energy Minimization”. In *10th International Workshop on Artificial Intelligence and Statistics (AISTATS)*, Barbados, January 2005.
- ◇ V. Kolmogorov, R. Zabih, S. Gortler. “Generalized Multi-camera Scene Reconstruction using Graph Cuts”. In *4th International Workshop on Energy Minimization Methods in Computer Vision and Pattern Recognition (EMMCVPR)*, Lisbon, Portugal, July 2003.
- ◇ Y. Boykov, V. Kolmogorov. “An Experimental Comparison of Min-Cut/Max-Flow Algorithms for Energy Minimization in Vision”. In *3rd International Workshop on Energy Minimization Methods in Computer Vision and Pattern Recognition (EMMCVPR)*, Sophia-Antipolis, France, LNCS 2134, p. 359, Springer, September 2001.

Technical Reports

- ◇ Y. Bachrach, P. Kohli, V. Kolmogorov, M. Zadimoghaddam. “Optimal Coalition Structures in Graph Games”. Technical Report arXiv:1108.5248v1, August 2011.
- ◇ V. Kolmogorov. “Minimizing a sum of submodular functions”. Technical Report arXiv:1006.1990v1, June 2010.

Medical Imaging

- ◇ V. Kolmogorov, T. D. Nguyen, A. Nuval, P. Spincemaille, M. R. Prince, R. Zabih, Y. Wang. “A Multi-processor Scheduling Implementation of the Simultaneous Multiple Volume (SMV) Navigator Method”. *Journal of Magnetic Resonance in Medicine*, 52:362-367, 2004.
- ◇ V. Kolmogorov, R. Watts, M. R. Prince, R. Zabih, Y. Wang. “Simultaneous Multiple Volume (SMV) Acquisition Algorithm for Real-Time Navigator Gating”. *Journal of Magnetic Resonance Imaging*, 21:9, pages 969-975, 2003.

Invited talks and tutorials

- ◇ Santaló's Summer School on Mathematics and Image Processing, Santander, Spain, August 2011 (4-hours tutorial)
- ◇ Workshop on Algebra and CSPs, Fields Institute, Toronto, Canada, August 2011.
- ◇ EMMCVPR workshop, Saint Petersburg, Russia, July 2011 (keynote speaker).
- ◇ Summer School on Image Processing, Szeged, Hungary, July 2011.
- ◇ Theory group seminar, Durham University, UK, December 2010.
- ◇ 1-week workshop in Kiev, Ukraine, September-October 2010.
- ◇ International Workshop on Tractability, Cambridge, UK, July 2010.
- ◇ ECCV 2010 Area Chair Colloquium, Paris, France, June 2010.
- ◇ GraphiCon conference, Moscow, Russia, October 2009 (keynote speaker).
- ◇ Heriot Watt University, Edinburgh, UK, August 2009.
- ◇ Workshop on "Statistical and Geometrical Approaches to Visual Motion Analysis", Dagstuhl, Germany, July 2008.
- ◇ "Discrete optimization methods in computer vision". Tutorial at ICCV 2007 (jointly with Y. Boykov, N. Komodakis and P. H. S. Torr), Rio de Janeiro, Brazil, October 2007.
- ◇ Zhukin, Ukraine, July 2007.
- ◇ Mini-Symposium on "Interacting with Still and Moving Images: From Signals to Semantics", Windermere, UK, July 2007.
- ◇ University of Liverpool, Dept. of Mathematical Sciences, UK, February 2007.
- ◇ University of Surrey, UK, July 2006.
- ◇ Pattern Recognition and Computer Vision Colloquium, Czech Technical University, Prague, October 2006.
- ◇ Gatsby Machine Learning Journal Club, London, September 2005.
- ◇ "Graph cuts versus level sets". Full-day tutorial at ECCV 2006 (jointly with Y. Boykov and D. Cremers), Graz, Austria, May 2006.
- ◇ GDR Workshop (Optimisation Discrète, Graph Cuts et Analyse d'Images), Paris, November 2005.
- ◇ University College London, Adastral Park, July 2005.
- ◇ Oxford University, June 2005.
- ◇ INRIA, Grenoble, August 2003.
- ◇ Microsoft Research, Cambridge, August 2003.
- ◇ ALADDIN Workshop on Graph Partitioning in Vision and Machine Learning, Carnegie Mellon University, January 2003.

Supervision

- ◇ Onno Zoeter, intern at Microsoft Research, summer 2005.
- ◇ Vinay Namboodiri, visiting student, August - September 2006.
- ◇ Sara Vicente, PhD student, April 2007 - current.

Awards

- ◇ Honorable mention, outstanding student paper award (to M. Pawan Kumar) at Neural Information Processing Systems Conference, 2007.
- ◇ The Royal Academy of Engineering/EPSRC Research Fellowship, 2006-2011.
- ◇ Best paper honorable mention award at IEEE Conference on Computer Vision and Pattern Recognition, 2005.
- ◇ Best paper award at the European Conference on Computer Vision, 2002.
- ◇ Soros grant, 1995.
- ◇ Second degree diploma at the Russian National Olympiad in Physics, 1994.
- ◇ Second degree diploma at the Russian National Olympiad in Physics, 1993.
- ◇ Fourth degree diploma at the Russian National Olympiad in Physics, 1993.

Professional activities

Event organisation:

- ◇ International Programme Committee Co-Chair of GraphiCon 2008, Moscow, June 2008.
- ◇ 5-day IPAM Workshop on “Graph Cuts and Related Discrete or Continuous Optimization Problems”, Los Angeles, February 2008.

Area chair:

- ◇ European Conference on Computer Vision (ECCV), 2010.

Program committee:

- ◇ European Conference on Computer Vision (ECCV), 2006, 2008.
- ◇ IEEE International Conference on Computer Vision (ICCV), 2005, 2007, 2009.
- ◇ IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2005, 2006, 2007, 2008.
- ◇ International Workshop on Energy Minimization Methods in Computer Vision and Pattern Recognition (EMMCVPR), 2009.
- ◇ International Conference on Artificial Intelligence and Statistics (AISTATS), 2010.

Reviewer for:

- ◇ IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI).
- ◇ International Journal of Computer Vision (IJCV).
- ◇ Combinatorial Optimization and Applications (COAP).
- ◇ IEEE International Conference on Computer Vision (ICCV), 2001.
- ◇ IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2001, 2003.
- ◇ International Workshop on Energy Minimization Methods in Computer Vision and Pattern Recognition (EMMCVPR), 2001, 2007.
- ◇ ACM SIGGRAPH 2005, 2006.
- ◇ Advances in Neural Information Processing Systems (NIPS), 2008, 2009, 2010, 2011.