

# Antonina Kolokolova

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## Research Interests

Theoretical computer science, in particular complexity theory, proof complexity and logic, as well as their applications.

## Education

- Ph.D. Computer Science: University of Toronto, 2005  
Supervisor: Stephen A. Cook  
Thesis: *Theories of arithmetic from descriptive complexity*
- M.Sc. Computer Science: University of Toronto, 2000  
Supervisor: Stephen A. Cook  
Thesis: *V-Horn: a Horn-based second-order theory of arithmetic*
- B. Sc. Computer Science and Mathematics: University of Arizona, 1998.  
Honours thesis in Computer Science on proof complexity, supervised by Toniann Pitassi.  
Honours thesis in Mathematics on dynamical systems, supervised by William Schaffer.

## Academic employment

- July 2007 - now: Department of Computer Science, Memorial University of Newfoundland.
  - Sep 2015-now: Associate professor.
- Jan 2005– May 2007: Postdoctoral fellow, School of Computing Science, Simon Fraser University (supported in part by PIMS).
- Sep 2004–Dec 2004, May 2005–Aug 2005: Visiting scientist, Mathematical Institute of Czech Academy of Sciences in Prague, Czech Republic.
- *Instructorships*
  - Fall 2005, Spring 2007: Simon Fraser University
  - Winter 2004: York University
  - Summer, Fall 2003, Winter 2004: University of Toronto.

## Publications

### In refereed journals:

- Jiawei Gao, Russell Impagliazzo, Antonina Kolokolova, Ryan Williams, “Completeness for First Order Properties on Sparse Structures with Algorithmic Applications”, invited to the special issue of ACM Transactions on Algorithms (TALG).

- Noah Fleming, Antonina Kolokolova, and Renesa Nizamee. “Complexity of alignment and decoding problems: restrictions and approximations.” *Machine Translation* (2015): 1-25.
- Ruiwen Chen, Valentine Kabanets, Antonina Kolokolova, Ronen Shaltiel, and David Zuckerman. “Mining Circuit Lower Bound Proofs for Meta-Algorithms.” *Computational Complexity* 24(2): 333-392, 2015
- Tamkin Khan Avi, Antonina Kolokolova, Adam Murphy, Richard Bajona, Kenneth Collingwood, Melissa Reid, ”Glider mission planning using generic solvers”, *Journal of Ocean Technology* 2(9):49-67, 2014
- Antonina Kolokolova, “ Expressing vs. proving: relating forms of complexity in logic” , *Journal of Logic and Computation* 22(2): 267-280, 2012
- Stephen Cook and Antonina Kolokolova, “A second-order system for polytime reasoning based on Grädel’s theorem”, *Annals of Pure and Applied logic* 124: 193-231, 2003.

*In refereed conferences:*

- Samuel R. Buss, Valentine Kabanets, Antonina Kolokolova, Michal Koucký, “Expander construction in  $VNC^1$ ”, to appear in *Innovations in Theoretical Computer Science (ITCS’17)*, 2017.
- Jiawei Gao, Russell Impagliazzo, Antonina Kolokolova, Ryan Williams, “Completeness for First Order Properties on Sparse Structures with Algorithmic Applications”, to appear in *ACM-SIAM Symposium on Discrete Algorithms (SODA’17)*, 2017.
- Marco Carmosino, Russell Impagliazzo, Valentine Kabanets, and Antonina Kolokolova, “Learning algorithms from Natural Proofs”, in *Computational Complexity Conference (CCC’16)*, 2016: 10:1-10:24 (**Best paper award**).
- Abdullah-al-Mamun, Antonina Kolokolova, Dan Brake “Detecting Contextual Anomalies from Time-Changing Sensor Data Streams”, at *ECML PKDD’15 (PhD Consortium)*, 2015.
- Marco Carmosino, Russell Impagliazzo, Valentine Kabanets, and Antonina Kolokolova. “Tighter Connections between Derandomization and Circuit Lower Bounds” In *LIPICs-Leibniz International Proceedings in Informatics*, vol. 40. Schloss Dagstuhl-Leibniz-Zentrum fuer Informatik (RANDOM 2015), 2015.
- Ruiwen Chen, Valentine Kabanets, Antonina Kolokolova, Ronen Shaltiel, David Zuckerman “Mining Circuit Lower Bound Proofs for Meta-Algorithms”, in *proceedings of 29th IEEE Conference on Computational Complexity (CCC 2014)*, pages 262-273.
- Antonina Kolokolova, Yongmei Liu, David G. Mitchell and Eugenia Ternovska, “On complexity of Model expansion.”, at *17th International Conference on Logic for Programming, Artificial Intelligence and Reasoning (LPAR-17, 2010)*, LNCS 6397, pages 447-458.
- Russell Impagliazzo, Valentine Kabanets, Antonina Kolokolova, “An axiomatic approach to algebrization”, in *proceedings of 41st ACM Symposium on Theory of Computing (STOC 2009)*, pages 695-704.

- Antonina Kolokolova, “Many facets of complexity in logic”, invited paper at Computability in Europe (CiE 2008), LNCS 5028, pages 316-325.
- Antonina Kolokolova, “Closure properties of weak systems of bounded arithmetic”, in proceedings of the 14th Conference on Computer Science Logic (CSL 2005), pages 369-383.
- Stephen Cook and Antonina Kolokolova, “A second-order theory of NL”, in Proceedings of the 19th annual IEEE symposium on Logic in Computer Science (LICS 2004), pages 398-407.
- Stephen Cook and Antonina Kolokolova, “A second-order system for polytime reasoning based on Grädel’s theorem”, in proceedings of the 16th annual IEEE symposium on Logic in Computer Science (LICS 2001), pages 177-186.

Surveys/book chapters:

- Antonina Kolokolova “Complexity barriers as independence”, invited chapter in ”The Incomputable - Journeys beyond the Turing barrier”, ed. Barry Cooper and Mariya Soskova (Springer), 2016. ISBN 978-3-319-43667-8

Peer-reviewed electronic colloquia:

- Samuel R. Buss, Valentine Kabanets, Antonina Kolokolova, Michal Koucký “Expander construction in  $VNC^1$ ”, Electronic Colloquium on Computational Complexity technical report TR16-144, 2016.
- Marco Carmosino, Russell Impagliazzo, Valentine Kabanets, and Antonina Kolokolova, “Algorithms from Natural Lower Bounds”, Electronic Colloquium on Computational Complexity technical report TR16-008, 2016.
- Ruiwen Chen, Valentine Kabanets, Antonina Kolokolova, Ronen Shaltiel, David Zuckerman “Mining Circuit Lower Bound Proofs for Meta-Algorithms”, Electronic Colloquium on Computational Complexity technical report TR13-057, 2013
- Valentine Kabanets and Antonina Kolokolova, “Compression of Boolean functions”, Electronic Colloquium on Computational Complexity technical report TR13-024, 2013
- Stephen Cook and Antonina Kolokolova, “A second-order system for polynomial-time reasoning based on Grädel’s theorem”, Electronic Colloquium on Computational Complexity technical report TR01-024, 2001.

Short papers, workshops and other:

- Antonina Kolokolova, Renesa Nizamee, “Approximating solution structure of the weighted sentence alignment problem”, arXiv:1409.2433 [cs.CL]
- Antonina Kolokolova, Renesa Nizamee, “Approximating optimal solution structure with edit distance and its applications”, informal proceedings/presentation at *Computability in Europe (CiE)* 2014.
- Antonina Kolokolova, Kenneth Collingwood, Melissa Reid “SAT Solvers for AUV Mission Planning”, Workshop on Underwater Robotics, May 2011.

- Russell Impagliazzo, Valentine Kabanets, Antonina Kolokolova, “An axiomatic approach to barriers in complexity”, invited paper at Greifswald 2010 workshop “Logical Approaches to Barriers in Computing and Complexity”.
- Antonina Kolokolova, Yongmei Liu, David G. Mitchell and Eugenia Ternovska, “On complexity of Model expansion.”, short paper at 16th International Conference on Logic for Programming, Artificial Intelligence and Reasoning (LPAR-16, 2010).
- Antonina Kolokolova, Yongmei Liu, David G. Mitchell and Eugenia Ternovska, “Model expansion and the expressiveness of FO(ID) and other logics”. Simon Fraser University technical report TR2007-29, 2007
- Antonina Kolokolova, Yongmei Liu, Eugenia Ternovska and David Mitchell, “Complexity of Expanding a Finite Structure and Related Tasks”, workshop on Logic and Computational Complexity (LCC 2006).
- Preparation of a manuscript for lectures by Steven Rudich and Avi Wigderson at the IAS/Park City Summer School 2000, published as IAS/Park City Mathematics Series volume 10 “Computational Complexity Theory”, Steven Rudich and Avi Wigderson (editors).

In preparation/submitted

- Russell Impagliazzo, Valentine Kabanets, Antonina Kolokolova, Pierre McKenzie and Shadab Romani, “Does looking inside a circuit help?”

Invited/plenary talks

- *4th Lund Conference on Games, Interaction, Reasoning, Learning and Semantics*, Lund, Sweden, 2016
- *Very Informal Gathering of Logicians*, UCLA, Los Angeles, USA 2013
- *Turing100.nl*, Amsterdam, Netherlands, 2012.
- *The Incomputable* workshop, Newport Pagnell, UK, 2012
- The International Workshop *Logical approaches to Barriers in Computing and Complexity*, Greifswald, 2010.
- *Computability in Europe: Logic and Theory of Algorithms (CiE 2008)* conference.

Invited special programs and long-term visits

- University of California, San Diego (San Diego, CA, USA): visiting professor, Jan-July 2016
- Simons Institute (Berkeley, CA, USA): long-term participant in *Fine-Grained Complexity and Algorithm Design*, Aug-Dec 2015.
- Newton institute (Cambridge, UK): invited participant in a special program *Syntax and Semantics: On aspects of Turing’s work*, April-July 2012; seminar May 2012.
- Institute for Advanced Study (Princeton, NJ, USA): visitor, Sep 2009-May 2010.

## Invited workshops

- Fields institute (Toronto, ON): *Theoretical foundations of SAT solving*, 2016
- Simons Institute (Berkeley, CA, USA) Four workshops associated with “Fine-Grained Complexity and Algorithm Design” program, 2015
- Schloss Dagstuhl - Leibniz-Zentrum für Informatik GmbH (Germany) *Resource-bounded problem solving* 2014.
- Rome, Italy *Limits of Theorem Proving* workshop, 2012
- Newton Institute (Cambridge, UK) workshop *The Incomputable*, 2012.
- Bellairs research station (Barbados) *Workshop on Computational Complexity*, 2007, 2008, 2009,2010,2011,2012,2013,2014, 2015, 2016.
- Mathematisches Forschungsinstitut Oberwolfach (Germany) *Mathematical Logic: Proof theory, Constructive Mathematics*, 2008,2011, 2014
- Newton’s Institute (Cambridge, UK) *New Directions in Proof Complexity*, 2006
- Banff International Research Station for Mathematical Innovation and Discovery (BIRS; Banff, Canada) workshops on *Advances in Computational Complexity*, 2004, 2006, 2008,2010, 2013, 2016
- Institute for Advanced Study workshop on *Complexity of Proofs and Computations* (Princeton,USA), 2001.

## Invited seminars and visits

- Université de Montréal: seminar, June 28, 2016
- University of California, San Diego: seminar, May 16, 2016
- Caltech: seminar, Feb 4, 2016
- University of Washington: seminar, Jan 12, 2016
- Université de Montréal: seminar, June 30, 2015
- University of Toronto: seminar, June 18, 2015
- University of California, San Diego: seminar, Jul 11, 2014
- Invited speaker at Harvard/MIT logic seminar, Harvard, Apr 15, 2013
- Math department, MUN. Oct 22, 2012.
- Institut für Informatik of the Ludwig-Maximilians-Universität München (München, Germany): seminar, Oct 2nd, 2012
- Mathematical Institute AV CZ (Prague, Czech Republic): visitor+seminar, Jul 7-15, 2012

- University of Edinburgh (Edinburgh, UK): seminar, Jun 8th, 2012
- Tohoku University (Sendai, Japan): seminar, Jul 22nd, 2011.
- Tokyo Institute of Technology (Tokyo, Japan): visitor, June-August 2011
- Simon Fraser University (Vancouver, Canada): departmental seminar, Apr 26,2011.
- Technion, (Haifa, Israel): visitor+seminar, Jul 8-24, 2010.
- CUNY logic workshop, New York (USA): seminar, Apr 23, 2010.
- Institute for Advanced Study (USA): visitor, Sep 2009 – May 2010.

### Research funding

- 2015-now: NSERC Discovery grant, \$29,000/year for 5 years.
- Aug 2014-Jan 2015: NSERC Engage, \$17,500 for 6 months.
- Jan 2011 - Oct 2013: RDC IRIF Ignite, \$98,500 for 2 years.
- 2008-2015: NSERC Discovery grant, \$16,000/year for 5 years.

### Awards and scholarships

- Best paper award at the Computational Complexity Conference (CCC), 2016.
- Computer Science Society Teaching Excellence award, 2015.
- Glenn Roy Blundon Centre for Students with Disabilities letter of appreciation, 2015.

### Academic service

- *Conference and workshop organization:*
  - *Algorithms and data structures symposium (WADS) 2017*, St. John’s (Canada). **Local organizer and PC co-chair.**
  - *Theoretical foundations of applied SAT solving*, 2014 at Banff International Research Station for Mathematical Innovation and Discovery (BIRS; Banff, Canada)
  - *Proof complexity*, 2011 at Banff International Research Station for Mathematical Innovation and Discovery (BIRS; Banff, Canada)
- *Program committee:*
  - “Logic in Computer Science” conference (LICS’2018), Oxford (UK), 2018
  - “2017 Annual ASL (association for symbolic logic) meeting”, Boise (USA), 2017
  - “Logic and Computational Complexity” workshop (LCC’15), Kyoto (Japan), 2015
  - “Algorithms and data structures symposium” (WADS’15), Victoria (Canada), 2015
  - “Computability in Europe” conference (CiE’15), Bucharest (Romania),2015
  - “Logic in Computer Science” conference (LICS’13), New Orleans (USA), 2013
  - “Computability in Europe” conference (CiE’13), Milano (Italy),2013

- “Turing in Context II” workshop, Brussels (Belgium), 2012.
- “Atlantic Provinces Council on the Sciences” (APICS’09), Halifax (Canada), 2009
- *Editorial*: On editorial board of Mathematical Logic Quarterly. Jan 2013 – now.
- *Refereeing*: Annals of Pure and Applied Logic, Discrete Applied Math. Journal, Archive for Math. Logic, Journal of Logic and Computation, Computational Complexity journal, Logic in Computer Science (LICS) conference, Foundations of Computer Science( FOCS) conference, Transactions on Computational Logic, Fundamenta Informaticae, Math Reviews
- *Theses reviews/examiner* 2 PhD, 1 habilitation, 2 MSc.

### Student supervision

- Graduate students:
  - Rida Albira (PhD, co-supervised): Sep 2016-now.
  - Shadab Romani (MSc, co-supervised): Apr 2015-July 2016. Completed. Thesis title: “Succinct representations of Boolean functions and the Circuit-SAT problem”.
  - Mst. Mausumi Sabnam Mustari (SciComp MSc): Jan 2015-now.
  - Abdullah al Mamun (MSc): Sep 2013 – Jan 2016. Completed. Thesis title: “Anomaly Detection from Time-Changing Environmental Monitoring Sensor Data Streams”.
  - Abdullah Faruq (MSc): Sep 2012 – now. Thesis title: “Planning an interesting path”.
  - Tamkin Avi (MSc): May 2012 – October 2014. Completed. Thesis title: “Glider mission planning using generic solvers”.
  - Renesa Nizamee (MSc): Sep 2009 – July 2014. Completed. Thesis title: “The intrinsic hardness of structure approximation”.
  - Scott McCarthy (MSc, co-supervised): Sep 2007 – April 2011. Withdrawn.
- Undergraduate honours students:
  - Noah Fleming: Honours thesis completed winter 2015.
  - Adam Murphy: Honours thesis completed summer 2013.
  - Robert Robere: Honours thesis completed summer 2011.
- Course-based MSc project supervision:
  - Norbert Obiekwe, completed summer 2013
- Undergraduate research assistants:
  - Noah MacAulay: Sep 2016-now
  - Noah Fleming: May 2013 – August 2015
  - Adam Murphy: Sep 2012 – August 2013
  - Richard Bajona: Feb 2011 – Nov 2013
  - Ken Collingwood: May – August 2011

- Melissa Reid: May – August 2011
- Robert Robere: Feb 2010 – Dec 2011
- Olivemarie Garland: Sep 2009 - Apr 2010
- Molham Kamel: Mar 2008 – Aug 2008

### Departmental service

- *Departmental committees*

- Undergraduate curriculum development: Nov 2012-Aug 2014.
- Promotion and tenure: Sep 2012- Aug 2013.
- Search committee: 2011-2012, Sep 2013- July 2014.
- Undergraduate studies: Sep 2009 – Aug 2010, Winter 2011, Sep 2016 – now.
- Graduate studies: Feb 2008 – Aug 2009, Winter 2011 – Aug 2013. Sep 2014 – Aug 2014, Jan 2017 – now.
- Programming competition: Fall 2009, Winter 2011 – Aug 2015.
- Departmental seminars organization: Jan 2008 – Aug 2015, Sep 2016 – now.
- Media and marketing: Sep 2007 – Aug 2009, Sep 2011 – Aug 2013, Sep 2016 – now.

- *University committees*

- Faculty of Science Library committee: Sep 2016-now.

- *Outreach*

- “Let’s talk science: Lab Extravaganza” event organization: Winter 2013, 2014, 2015
- Open house organization: Fall 2011
- High school interviewing: May 2011.