

# Irina A. Kogan

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## CONTACT INFORMATION

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## RESEARCH INTERESTS

Geometry of differential equations; problems of equivalence and symmetry under group actions; computational invariant theory: algebraic and differential; geometric methods in computer image recognition and image processing.

## EDUCATION

**University of Minnesota**, Minneapolis, MN

Ph.D. in Mathematics, June 2000

Advisor: Peter Olver

Thesis: *Inductive Approach to Cartan's Moving Frame Method with Applications to Classical Invariant Theory*

**Institute for Petrochemical and Natural Gas Industry**, Moscow, Russia

Diploma in Applied Mathematics (equivalent of MS), May 1993

Advisor: Nicolay Osetinsky

Diploma Project: *Applications of Invariant Theory to Classical Mechanics*

## ACADEMIC EXPERIENCE

**North Carolina State University**, Raleigh, NC: Assistant Professor, 2003–present

**Yale University**, New Haven, CT: Gibbs Instructor, 2000–2003

**University of Lille-1**, France: Visiting Assistant Professor, June 2002

**INRIA, Sophia-Antipolis**, France: Visiting Researcher, June 2001

## HONORS AND AWARDS

2007-2009 Research Grant, National Science Foundation, PI

Project: *Symbolic Group-Invariant Computation*

2007-2009 Noyce Mathematics Education Teaching Scholars Grant, National Science Foundation, co-PI. Grant provides scholarships for students aiming to teach mathematics in a high school.

2006-2007 NCSU Faculty Center for Teaching and Learning Grant, PI

Project: *Integrating Dynamic Geometry Software in a College Geometry Course*

2005-2008 SCREMS Grant, National Science Foundation, co-PI.

Equipment grant for the project: *Parallel Symbolic Computation*

2005 Best poster award, International Symposium on Symbolic and Algebraic Computations (ISSAC)

2005 Association for Women in Mathematics Travel Award to make a presentation at the Foundations of Computational Mathematics conference, Santander, Spain

2004-2005 Faculty Research and Professional Development Award, NCSU. Project: *Symmetry Reduction in the Variational Calculus*

2000-2003 Gibbs Instructorship, Yale University

2000 American Mathematical Society Travel Award to attend AMS special meeting *Mathematical Challenges of the 21st Century*, Los Angeles, CA

2000 Outstanding Thesis Award, University of Minnesota

1993 Honors Award on Graduation, Institute for Petrochemical and Natural Gas Industry, Moscow, Russia

#### PEER REVIEWED PUBLICATIONS

1. Feng, S., Kogan, I. A. and Krim, H., *Classification of curves in 2D and 3D via affine integral signatures*. accepted to *Acta Appl. Math.* (2008) 30 pp. Preprint is posted at <http://arxiv.org/abs/0806.1984v1>
2. Hubert, E., Kogan, I.A. Smooth and algebraic invariants of a group action. Local and global constructions. *Foundations of Computational Math. J.* Volume 7, Number 4 (2007) pp. 345-383.
3. Hubert, E., Kogan, I.A. Rational invariants of a group action. Construction and rewriting. *J. of Symb. Comp.* 42 (2007) pp. 203–217.
4. Feng, S., Kogan, I. A., Krim, H. Integral invariants for curves in 3D: Inductive construction. *IS&T/SPIE joint symposium, Visual Communication and Image Processing conference (VCIP), San Jose, CA* (2007) 11 pp.
5. Feng, S., Krim, H., Kogan, I.A. 3D Face recognition using Euclidean integral invariant signature. *Proceedings of the IEEE/SP 14th Workshop on Statistical Signal Processing (SSP)* (2007) pp. 156–160.
6. Aouda, D., Feng, S., Krim, H., Kogan, I.A. 3D mixed invariant and its application in object classification. *International Conference on Acoustics, Speech, and Signal Processing (ICASSP)* (2007) pp. 461–464.
7. Hollebrands, K., Smith, R., Iwancio, K., Kogan, I. A. The affects of a dynamic program for geometry on college students understandings of properties of quadrilaterals in the Poincare Disk model. *Proceedings of the 9th International Conference on Mathematics Education in a Global Community* (2007) pp. 613–618.
8. Hollebrands, K., Smith, R., Iwancio, K., Kogan, I. A. College geometry students uses of technology in the process of constructing arguments. *Proceedings of the 29th Annual Conference of the North American Chapter of the International Group for the Psychology of Mathematics Education. (T. Lamberg, Ed.)* (2007) 7pp. (electronic)

9. Baloch, S., Krim, H., Kogan, I. A., Zenkov, D. V. Rotation invariant topology coding of 2D and 3D objects using Morse theory. *Proc. of IEEE International Conference on Image Processing (ICIP)* (2005) pp. 796–799.
10. Baloch, S., Krim, H., Kogan, I. A., Zenkov, D. V. 3D object representation with topo-geometric shape models. *Proc. of European Signal Processing Conference (EUSIPCO)* (2005) 4pp. (electronic).
11. Kogan, I. A., Olver, P. Invariant Euler-Lagrange equations and the invariant variational bicomplex, *Acta Appl. Math.* 76 (2003) 137–193.
12. Kogan, I. A. Two algorithms for a moving frame construction, *Canad. J. Math.*, 55 no 2 (2003) pp. 266–291.
13. Kogan, I. A., Moreno Maza, M. Computation of canonical forms for ternary cubics. *Proc. of International Symposium on Symbolic and Algebraic Computation (ISSAC)* (2002) pp.151–160.
14. Kogan, I. A., Olver, P. The invariant variational bicomplex, *Contemp. Math., AMS* 285 (2001) 131–144.
15. Kogan, I. A. Inductive construction of moving frames, *Contemp. Math., AMS* 285 (2001) pp. 157–170.
16. Kogan, I. A., Olver, P. Symmetries of polynomials, *J. of Symb. Comp.*, 29 (2000) pp. 485–514 (published under name: Berchenko, Irina).

#### SUBMITTED

1. Jenssen, H. K., and Kogan, I. A. *Construction of Conservative Systems* (2008) 10 pp. (submitted) <http://www4.ncsu.edu/iakogan/papersPDF/JenssenKogan-hyp.pdf>

#### JOURNAL PUBLICATIONS IN PREPARATION

1. Jenssen, H. K., Kogan, I. A. Systems of hyperbolic conservation laws with prescribed eigencurves.
2. Burdis, J., Kogan, I. A. Algorithmic approach to differential and variational calculus in invariant frames.
3. Kogan, I. A. Noether’s correspondence in the invariant variational complex.
4. Feng, S., Kogan, I. A., Krim, H. Face representation and recognition using Euclidean-invariant integral signatures.

PRESENTATIONS (since employed at NCSU in reverse chronological order)

- MSRI workshop on *Exterior Differential Systems and the Method of Equivalence*, May 5-9, 2008. Invited talk entitled “Hyperbolic Conservation Laws with Prescribed Eigencurves ” joint with and presented by Kris Jenssen
- Colloquium, Appalachian State University, October 5, 2007, two invited talks entitled: “A Hands-on Approach to Teaching and Learning Non-Euclidean Geometry” and “Geometric Invariants in Computer Image Recognition”
- Special session on *Symbolic Symmetry Analysis and its Applications*, at the Application of Computer Algebra (ACA) Conference, July 19-22, 2007, co-organizer, talk entitled “Differential and Variational Calculus relative in Invariant Frames”.
- SAMSI Summer Program on the *Geometry and Statistics of Shape Spaces*, July 7-13, 2007, poster entitled “Classification of Curves in 3D via Affine Integral Invariant Signatures”
- Second Workshop for NCSU/China Research and Education Partnership in Symbolic Computation, Hangzhou, China, March 5–9, 2007, talk entitled “ A Smooth and Algebraic Invariants of a Group Action”
- IS&T/SPIE joint symposium, *Visual Communication and Image Processing* conference (VCIP), San Jose, CA, January 28-31, 2007, invited talk entitled “Affine Integral Invariants for Curves in 3D”
- Institute of Mathematics and Applications (IMA) workshop on *Algorithms in Algebraic Geometry*, September 18-22, 2006, poster entitled “Smooth and Algebraic Invariants of a Group Action: Local and Global Constructions.”
- Institute of Mathematics and Applications (IMA) summer program on *Symmetries and Overdetermined Systems of Partial Differential Equations*, July 17-August 4, 2006, invited talk entitled “Differential and Variational Calculus in Invariant Frames.”
- Algebraic Geometry Seminar, Tel Aviv University, March 7, 2006, invited talk entitled “Smooth and Algebraic Invariants”.
- Special session on *Geometry of Differential Equations* at the AMS Central Section Meeting, Lincoln, Nebraska, October 21–23, 2005, co-organizer, talk entitled “Variational Calculus in Moving Frames: Symbolic Computation and Applications”
- Differential Geometry Seminar, Duke University, September 27, 2005, invited talk entitled “Variational Calculus in Moving Frames: Symbolic Computation and Applications.”
- First Workshop for NCSU/China Research and Education Partnership in Symbolic Computation, Raleigh, NC, October, 2005, talk entitled “Differential Invariants: Computations and Applications.”
- Algebra Seminar, NCSU, September 9, 2005, talk entitled “Smooth, Rational and Replacement Invariants”

- International Symposium on Symbolic and Algebraic Computations (ISSAC) 2005, Beijing, China, July 24–27, contributed poster entitled, “Rational and Replacement Invariants of a Group Action” joint with and presented by E. Hubert.
- Foundations of Computational Mathematics conference (FoCM), Santander, Spain, June 30–July 9, 2005, invited talk “Variational Calculus in Moving Frames: Symbolic Computation and Applications.”
- Session on *Invariant Theory and Differential Geometry*, Canadian Mathematical Society meeting, June 4–6, 2005, Waterloo, invited talk entitled “Rational and Algebraic Invariants and the Moving Frame Method”
- Effective Methods in Algebraic Geometry conference (MEGA) 2005, Italy, May 27– June 1, 2005 contributed paper “Rational and Replacement Invariants” joint with and presented by E. Hubert
- The IV International Association for Mathematics and Computers in Simulation (IMACS) Conference on Nonlinear Evolution Equations and Wave Phenomena: Computation and Theory, Athens, Georgia, April 11–14 , 2005, invited talk entitled “Group-Invariant Frames: Symbolic Computation and Applications”
- The XI International Conference on *Symmetry Methods in Physics*, Prague, Czech Republic, June 21–24, 2004, contributed talk entitled “Noether correspondence for group-invariant variational problems”
- Session on *Applications of Invariant Theory to Differential Geometry*, Canadian Mathematical Society meeting, Halifax, June 13–16, 2004, invited talk entitled ”Noether correspondence for group-invariant variational problems.”
- Differential Algebra and Symbolic Computation Workshop, NCSU, April 27, 2004, talk entitled ”Noether correspondence for group-invariant variational problems”
- Computer Science Department, NCSU, VISSTA group seminar, April 16, 2004, invited talk entitled “Differential Invariants and Computer Vision”
- Math Physics seminar, two talks: March 25, April 1, 2004 entitled “Introduction to the Variational Bicomplex“
- Colloquium, Dalhousie University, Halifax, Canada, March 1, 2004, invited talk entitled “Cartan’s Method of Moving Frames and its Applications”
- The Mathematics Graduate Student Association, NCSU, February 19, 2004, talk entitled “Symmetry Methods for Differential Equations.”
- Special session on *Geometry of Differential Equations* at the 989-th AMS meeting, Boulder, CO, October 2–4, 2003, invited talk entitled “Moving Coframe on a Jet bundle: Symbolic Computation”
- Algebra Seminar, NCSU September 3, 2003, talk entitled “Orbits on the space of polynomials under  $GL(n, \mathbb{C})$  action”

## CONFERENCE ORGANIZATION

- Co-organizer of a special session on Geometry of Differential Equations at the AMS Spring Southeastern Sectional Meeting, Raleigh, North Carolina, scheduled April 4–5, 2009.
- Co-organizer of a special session on Symbolic Symmetry Analysis and its Applications at the International Conference on Applications of Computer Algebra (ACA), Hagenberg, Austria, July 27–30, 2008.
- Co-organizer of a special session on Symbolic Symmetry Analysis and its Applications at the International Conference on Applications of Computer Algebra (ACA), Rochester, Michigan, July 19–22, 2007.
- Co-organizer of a special session on Geometry of Differential Equations at the AMS Fall Central Section Meeting Meeting, Lincoln, Nebraska, October 21–25, 2005.

## TEACHING SUMMARY (NCSU, Fall 2003–Spring 2008)

		total # of sections	total #of students
MA141	Calculus I	1	47
MA241H	Calculus II	1	16
MA408	Foundations of Euclidean Geometry	6	170
MA 494	Math Major Writing Requirement	4	15
MA 555	Manifold Theory	2	15
MA 591I	Geometry of Differential Equations	1	6
MA 755	Introduction to Riemannian Geometry	1	6
MA 795F	Geometric Foundations of Relativity	1	7

## GRADUATE STUDENTS

- Lisa Bieryla, M. S. student, graduated May 2006
- Katie Thompson, Ph. D. student, expected graduation: Summer 2009
- Joseph Burdis, Ph. D. student, expected graduation: Summer 2010

## PH.D. THESIS COMMITTEES

2008	David Long	Department of Mathematics, NCSU, advisor Dmitry Zenkov
	Rayan Smith	Department of Math., Science & Technology Education, NCSU, advisor Karen Hollebrands
	Richard Brown	University of Canterbury, Department of Mechanical Engineering, New Zealand, advisor Chris Hann
	James Cook	Department of Mathematics, NCSU, advisor Ronald Fulp
	Jonathan Brown	Department of Mathematics, NCSU, advisor Larry Norris

2007	Shuo Feng	Department of Electrical and Computer Engineering, NCSU, advisor Hamid Krim
	Alexey Ovchinnikov	Department of Mathematics, NCSU, advisor Michael Singer
2005	Sajjad Baloch	Department of Electrical and Computer Engineering, NCSU, advisor Hamid Krim

#### UNDERGRADUATE STUDENT MENTORING

2007	Summer REU project mentor at NCSU; students: Alex Abatzoglou, Amanda Smith, Jessica WebsterLove
2007/2008	Organizer of undergraduate research presentations at the Department of Mathematics, NCSU
2007-present	Math Honors Program undergraduate advisor at NCSU; students: Evan Adamek, Sean Finch, Brian Hestetune, Leslie Watkins
2004-2006	Math Honors Program research project mentor at NCSU; students: Austin Waters, Barandyn Lee, Eric Kalendra, John Jenkins.
2004-present	Putnam seminar instructor

#### TEACHING MENTORING:

- Mentor for Preparing the Professoriate Program, NCSU, (the program gives graduate students an opportunity to teach upper level undergraduate classes), students: Kathleen Iwancio Thompson (2006/2007) and Joseph Burdis (2008/2009)
- Mentor for teaching assistants within math department, students Edward Rowe (Spring 2005), Morgan Root (Spring 2006), Kathleen Iwancio (Spring and Fall 2007).
- Teaching Workshop for Recitation Leaders (Spring 2005, Fall 2006 & Fall 2007): evaluating presentations by perspective TA's

#### OUTREACH ACTIVITIES IN MATHEMATICAL EDUCATION:

2005/2006 & 2007/2008	Coordinator of a "problem of the month" math contest (M6) for undergraduate students at NCSU ( <a href="http://www.math.ncsu.edu/undergrad/contests/m6/index.php">http://www.math.ncsu.edu/undergrad/contests/m6/index.php</a> )
2006	Participation on an invitation in a Mathematics Curriculum Review meeting at the Department of Public Instruction, Raleigh, NC
2004	A week-long lecture course on non-Euclidean Geometry at the Canada/USA summer Mathcamp for high-school students ( <a href="http://www.mathcamp.org">www.mathcamp.org</a> )

## PEER REVIEWING OF RESEARCH MANUSCRIPTS

- research article reviewer for Foundation of Computational Mathematics Journal, Journal of Lie Theory, Non-Linearity Journal, Journal of Physics A., Journal of Symbolic Computation, Journal of Lie Group Theory, Algebraic Biology Conference proceedings, ISSAC proceedings, Applied Mathematics Letters, Journal of Experimental Math, IEEE transactions on Image Processing
- book project reviewer for Springer-Verlag
- NSF proposal reviewer

## MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS

2006-present	Association of Women in Mathematics (AWM)
2003-present	Foundations of Computational Mathematics Society (FoCM)
1994-present	American Mathematical Society (AMS)