

Contact Information:

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Research Interests:

- Differential Geometry and Discrete Mathematics.
 - Hamiltonian group actions. Combinatorial aspects of equivariant cohomology.
 - Enumerative and algebraic combinatorics.
 - Applications in computer science and biology.

Education:

- Massachusetts Institute of Technology, Cambridge, MA.
 Ph.D., Mathematics June 2000
- University of Bucharest, Romania.
 M.S., Mathematics June 1995
 B.S., Mathematics June 1994

Employment:

- UMass Boston, Boston, MA
 Associate Professor (tenured), Department of Mathematics 2011-present
 Assistant Professor (tenure-track), Department of Mathematics 2006-2011
 Visiting Assistant Professor 2005-2006
- Penn State Altoona, Altoona, PA
 Assistant Professor (tenure-track), Department of Mathematics 2003-2006
 (on leave 2005-2006)
- Yale University, New Haven, CT
 J.W. Gibbs Instructor, Department of Mathematics 2000-2003
- MIT, Cambridge, MA
 Teaching Assistant, Department of Mathematics 1996-1999
- University of Bucharest, Romania
 Assistant, Department of Mathematics 1995-1996

Awards:

- Goodwin Medal, MIT 2000
 MIT's highest graduate student teaching award, given annually in recognition of
"conspicuously effective teaching over and above ordinary excellence."
- Housman Graduate Student Teaching Award, MIT 2000
 MIT Department of Mathematics award, given to graduate students in mathematics for
"skill and dedication in undergraduate teaching."
- Charles W. and Jennifer C. Johnson Prize, MIT 1999
 MIT Department of Mathematics award, given to a graduate student for
"an outstanding research paper accepted for publication in a major journal."
- Alfred P. Sloan Foundation Doctoral Dissertation Fellowship 1999-2000
- American Mathematical Society Project NExT Fellowship 2003-2004

Research

Publications

(Authors listed in alphabetical order)

Books:

- (1) Nicolescu, Liviu, Gabriel Priporae, and Catalin **Zara**.
Teoreme si probleme de grupuri Lie [*Theorems and Problems on Lie Groups*].
Editura Universitatii Bucuresti, Romania (1996). 188 pages.
- (2) Nicolescu, Liviu, Alexandru Bumbacea, Alin Catana, Paul Horja, Gheorghe G. Niculescu, Nicolae Oprea, and Catalin **Zara**.
Metode de Rezolvare a Problemelor de Geometrie [*Methods for Solving Geometry Problems*].
Editura Universitatii Bucuresti, Romania (1992). 2nd printing (1998). 374 pages.

Articles in Refereed Journals:

- (1) Guillemin, Victor, Silvia Sabatini and Catalin **Zara**.
“Polynomial Assignments.”
Indag. Math, DOI: 10.1016/j.indag.2014.07.008 (2014)
- (2) Guillemin, Victor, Silvia Sabatini and Catalin **Zara**.
“Balanced Bundles and GKM Theory.”
International Mathematical Research Notices, 17 (2013), pp. 3886–3910.
- (3) Guillemin, Victor, Silvia Sabatini and Catalin **Zara**.
“Equivariant K-theory of GKM Bundles.”
Annals of Global Analysis and Geometry 43 (2013), pp. 31–45.
- (4) Guillemin, Victor, Silvia Sabatini and Catalin **Zara**.
“Cohomology of GKM Fiber Bundles.”
Journal of Algebraic Combinatorics 35 (2012), pp. 19–59.
- (5) Baraty, Saaïd, Dan Simovici, and Catalin **Zara**.
“The Impact of Triangular Inequality Violations on Medoid-Based Clustering.”
Proceedings of ISMIS 2011, Warsaw, Poland. *Lecture Notes in Artificial Intelligence*, LNAI 6804, pp. 280–289.
- (6) **Zara**, Catalin.
“Positivity of Equivariant Schubert Classes through Moment Map Degeneration.”
Journal of Symplectic Geometry 8 (2010), no. 4, pp. 1–21.
- (7) **Zara**, Catalin.
“Morse Interpolation for Hamiltonian GKM Spaces.”
Journal of Differential Geometry 75 (2007), no. 3, 503–523.
- (8) Gil, Juan, Mike Weiner, and Catalin **Zara**.
“Complete Padovan Sequences in Finite Fields.”
Fibonacci Quarterly 45 (2007), no. 1, 64–75.
- (9) Guillemin, Victor, Tara Holm, and Catalin **Zara**.
“A GKM description of the equivariant cohomology ring of a homogeneous space.”
Journal of Algebraic Combinatorics 23 (2006), no. 1, 21–41.
- (10) **Zara**, Catalin.
“Chains, subwords, and fillings: strong equivalence of three definitions of the Bruhat

- order.”
Electronic Journal of Combinatorics 13 (2006), no. 1, Note 5, 13 pp. (electronic)
- (11) Guillemin, Victor, and Catalin **Zara**.
 “The existence of generating families for the cohomology ring of a graph.”
Advances in Mathematics 174 (2003), no. 1, 115–153.
- (12) **Zara**, Catalin.
 “Parking functions, stack-sortable permutations, and spaces of paths in the Johnson graph.”
Electronic Journal of Combinatorics 9 (2002/03), no. 2, Research paper 11, 11 pp. (electronic)
- (13) Guillemin, Victor, and Catalin **Zara**.
 “Combinatorial Formulas for Products of Thom Classes.”
Geometry, Mechanics, and Dynamics: Volume in Honor of the 60th Birthday of J. E. Marsden, pages 363–405. Edited by Paul Newton, Phil Holmes, and Alan Weinstein. New York: Springer-Verlag, 2002.
- (14) Guillemin, Victor, and Catalin **Zara**.
 “ G -actions on graphs.”
International Mathematics Research Notices 2001, no. 10, 519–542.
- (15) Guillemin, Victor, and Catalin **Zara**.
 “1-skeleta, Betti numbers, and equivariant cohomology.”
Duke Mathematical Journal 107 (2001), no. 2, 283–349.
- (16) Guillemin, Victor, and Catalin **Zara**.
 “Equivariant de Rham theory and graphs.”
Asian Journal of Mathematics 3 (1999), no. 1, 49–76. Republished in *Surveys in Differential Geometry, VII*, 221–257, Int. Press, Somerville, MA, 2000.
- (17) **Zara**, Catalin.
 “A characterization of bi-invariant Riemannian metrics on Lie groups.”
Studii si Cercetari Matematice (Math Reports) 50 (1998), no. 1-2, 111–115.
- (18) **Zara**, Catalin.
 “On a theorem of D. Müller.” (Romanian).
Studii si Cercetari Matematice (Math Reports) 47 (1995), no. 3-4, 359–363.

Other Articles

- Bolker, Ethan, Jeremy Hatch, and Catalin **Zara**.
 “Modeling bird passage through a windfarm.”
 Mathematical model and VBA macro implementing the model. arXiv:1408.1580. (2014)
- Dinu, Liviu and Catalin **Zara**.
 “Cardinality of ℓ_1 -Spheres in Permutation Spaces.” arXiv:1303.0016. (2013)
- **Zara**, Catalin.
 “Cardinality of ℓ_1 -Segments and Genocchi Numbers.” arXiv:1304.5798. (2013)
- Bolker, Ethan, Carl Offner, Robert Richman, and Catalin **Zara**.
 “The Prouhet-Tarry-Escott Problem and Generalized Thue-Morse Sequences.” arXiv:1304.6756. (2013)

Work in Progress

- Bolker, Ethan, Victor Guillemin, Tara Holm, and Catalin **Zara**.
 “GKM Graphs.” Book. Approximately 150 pages.

- Simovici, Dan and Catalin **Zara**.
“Probability Tools in Data Mining.” Book. Currently 200 pages.
- **Zara**, Catalin.
“Rank Distance Distinguishability on Spaces of Strings.”
- **Zara**, Catalin.
“Odd-Selectable Subsets.”

Presentations at Conferences and Workshops

- Jun 2012 Canadian Mathematical Society Summer Meeting,
Special Session on “Geometry and Topology of Lie Transformation Groups,”
Regina, SK.
“*Balanced Bundles and GKM Theory*”
- Jul 2011 The Seventh Congress of Romanian Mathematicians,
Section: “Theoretical Computer Science” Brasov, Romania.
“*Spearman footrule and rank distance: combinatorial and computational aspects*”
- Apr 2009 American Mathematical Society Eastern Section Meeting,
Special Session on “Symplectic and Contact Topology,” WPI, Worcester, MA.
“*GKM Fiber Bundles*”
- Aug 2008 Workshop on “Moment Maps,” EPFL, Lausanne, Switzerland.
“*Positivity of Equivariant Schubert Classes Through Moment Map Degeneration*”
- Mar 2008 American Mathematical Society Eastern Section Meeting,
Special Session on “Algebraic Combinatorial Geometry,” New York University, New York, NY.
“*Positivity in Equivariant Schubert Calculus: A Symplectic Approach*”
- Oct 2007 American Mathematical Society Eastern Section Meeting,
Special Session on “Invariants of Lie Group Actions and Their Quotients,”
Rutgers University, New Brunswick, NJ.
“*A New Proof of a Positive Formula for Equivariant Schubert Classes*”
- Jun 2007 Pacific Institute for Mathematical Sciences
Summer School on “Combinatorial Models in the Geometry and Topology of Flag Manifolds,” University of Regina, Canada. Four lectures on
“*Equivariant cohomology of flag manifolds*”
- Oct 2006 American Mathematical Society Eastern Section Meeting,
Special Session on “Combinatorial Methods in Equivariant Topology,”
University of Connecticut, Storrs CT.
“*Strong Equivalence of Three Definitions of the Bruhat Order and Consequences for the Equivariant Cohomology of Flag Manifolds*”
- May 2006 International Conference on “Toric Topology,” Osaka City University, Japan.
“*Hamiltonian GKM spaces and their moment graphs*”
- Apr 2004 Mathematisches Forschungsinstitut Oberwolfach (Germany)
Workshop on “Cohomological Aspects of Hamiltonian Torus Actions and Toric Varieties.”
“*Morse Interpolation for Hamiltonian GKM Spaces*”
- Dec 2002 Canadian Mathematical Society Winter Meeting,
Symposium on “Symplectic Geometry,” University of Ottawa, ON.
“*Morse Interpolation and Divided Differences*”

- Oct 2002 American Mathematical Society Eastern Section Meeting,
Special Session on “Modern Schubert Calculus,” Northeastern University, Boston MA.
“Divided Differences and Spaces of Subwords”
- Apr 2002 Conference on “Symplectic and Contact Geometry,”
MIT, Cambridge MA.
“Grothendieck Polynomials and Spaces of Paths”
- Jun 2001 Fields Institute for Research in Mathematical Sciences
Workshop on “Hamiltonian Group Actions and Quantization,” Toronto ON.
“Generators in Equivariant Cohomology and Equivariant K-Theory”
- Jun 2000 Canadian Mathematical Society Summer Meeting,
Symposium on “Symplectic Geometry,” Hamilton ON.
“Combinatorial Formulas for Products of Thom Classes”

Invited Speaker at Departmental Seminars and Colloquia

- Oct 2012 University of Bucharest, Romania - Theoretical Computer Science Colloquium.
- Mar 2010 MIT, Cambridge, MA - Combinatorics Seminar.
- Mar 2009 Johns Hopkins University, Baltimore, MD - Topology Seminar.
- May 2008 UMass Boston - Mathematics Seminar.
- Nov 2007 MIT, Cambridge, MA - Group Actions in Geometry Seminar.
- Nov 2005 UMass Boston - Mathematics Seminar.
- Nov 2005 UMass Lowell - Mathematical Sciences Seminar.
- Jun 2005 University of Bucharest, Romania - Differential Geometry Seminar.
- Oct 2004 George Mason University, Fairfax, VA - Mathematics Colloquium.
- Apr 2004 Penn State University, State College, PA - Topology/Geometry Seminar.
- Apr 2004 Chapman University, Orange, CA - Mathematics Seminar.
- Apr 2004 California State University, Fullerton CA - Mathematics Colloquium.
- Oct 2003 Penn State University, State College, PA - Topology/Geometry Seminar.
- Mar 2002 University of Bucharest, Romania - Differential Geometry Seminar.
- Nov 2001 University of Toronto, Toronto, ON - Symplectic Geometry Seminar.
- Nov 2001 Yale University, New Haven, CT - Topology Seminar.
- Mar 2001 University of California at Berkeley, Berkeley CA - Combinatorics Seminar.
- Feb 2001 State University of New York, Albany NY - Mathematics Colloquium.
- Feb 2001 Yale University, New Haven CT - Lie Groups Seminar.
- Nov 2000 MIT, Cambridge MA - Schubert Calculus Seminar.

Other Conferences Attended:

- Mar 2010 “Localization Techniques in Equivariant Cohomology,” American Institute of Mathematics, Palo Alto CA.
- Jun 2008 “Moment Maps,” Centre de Recerca Matematica, Universitat Autònoma de Barcelona, Spain.
- Jan 2008 “Mathematical Physics and Geometric Analysis,” Fields Institute, Toronto ON, Canada.
- May 2007 “Interactions between Algebraic Combinatorics and Algebraic Geometry” Workshop, Centre de Recherches Mathématiques, Montreal QC, Canada.

- May 2005 “Moment Maps in Various Geometries” Workshop, Banff International Research Station, Banff AB, Canada.
- Aug 2004 “Moment Maps and Surjectivity in Various Geometries” Workshop, American Institute of Mathematics, Palo Alto CA.
- Jun 2004 “Retrospective in Combinatorics” Conference, MIT, Cambridge MA.
- Aug 2000 “Mathematical Challenges of the 21st Century,” UCLA, Los Angeles CA.

Research Support:

- Travel Grant, American Institute of Mathematics, March 2010
- Travel Grant, EPFL - Bernoulli Center, Lausanne, August 2008
- Travel Grant, Osaka City University, Osaka, May 2006
- Research Development Grants, Penn State University, 2003-2005
- Travel Grant, American Institute of Mathematics, August 2004
- US Junior Oberwolfach Fellow Grant, NSF, April 2004
- VIGRE Gibbs Instructorship, Yale University, 2000-2003
- Travel Grant, Fields Institute, Toronto, June 2001
- Clay Mathematics Institute Liftoff Program, June-August 2000.
- Travel Grant, American Mathematical Society, August 2000.
- Travel Grants, Canadian Mathematical Society, August 2000, December 2002.

Other Research Activity:

- Research Affiliate, Department of Mathematics, MIT, September 2008 - present.
- Member, Ph.D. Thesis Committee, Department of Mathematics, MIT.
Candidate: Silvia Sabatini, 2009
- Member, Ph.D. Thesis Committee, Department of Computer Science, UMass Boston.
Candidate: Dan Pletea, 2013
- Consultant, Ph.D. Thesis Committee, Department of Mathematics, University Paris 7.
Candidate: Charles Cochet, 2003
- Refereed manuscripts for 13 journals and conference proceedings
 - Advances in Mathematics
 - Algebra, Geometry, and Applications Seminar Proceedings
 - Algebraic and Geometric Topology
 - Bulletin of the London Mathematical Society
 - CAARMS13 Proceedings
 - Discrete Mathematics
 - Experimental Mathematics
 - Geometry and Topology
 - Information Processing Letters
 - International Journal of Mathematics and Mathematical Sciences
 - International Mathematics Research Notes
 - Journal of Differential Geometry
 - Osaka Journal of Mathematics
 - Revue Africaine de la Recherche (ARIMA) Journal
- Reviewed 3 books and 42 articles for *Mathematical Reviews*.

Teaching

Teaching Experience:

Classes taught at UMass Boston (Fall 2005 - present)

- Math 140 - Calculus I
- Math 141 - Calculus II
- Math 240 - Multivariable Calculus
- Math 242 - Multivariable and Vector Calculus
- Math 260 - Linear Algebra
- Math 310 - Applied Ordinary Differential Equations
- Math 345 - Probability and Statistics
- Math 354 - Vector Calculus
- Math 356 - Differential Geometry
- Math 478 - Independent Study
 - Introduction to Topology
 - Mathematics for Finance
 - Applied Probability
 - Topics in Geometry
- Math 480 - Special Topics
 - Problem Solving Seminar
 - Topics in Combinatorics

Classes taught at Penn State Altoona (Fall 2003 - Spring 2005)

- Math 140 - Calculus with Analytic Geometry, I
- Math 141 - Calculus with Analytic Geometry, II

Classes taught at Yale University (Fall 2000 - Spring 2003)

- Math 115 - Calculus of Functions of One Variable
- Math 118 - Introduction to Functions of Several Variables
- Math 118S - Mathematics for Economists
- Math 225 - Linear Algebra and Matrix Theory
- Math 246 - Ordinary Differential Equations
- Math 435 - Differential Geometry

Classes taught at MIT (Winter 1997 - Summer 2000)

- Primary instructor for Calculus, Project Interphase (Summer 1998, 1999)
- Recitation instructor for
 - 18.022 Multivariable Calculus
 - 18.02A Multivariable Calculus - Intensive
 - 18.01 Calculus
 - 18.095 Mathematics Lecture Series
- Coordinator for the Mathematics Tutoring Center (Fall 1998).
- Mentor for
 - Research Science Institute (RSI)
 - Summer Program for Undergraduate Research

Classes taught at the University of Bucharest, Romania (1995-1996)

- Linear Algebra; Differential and Riemannian Geometry; Lie Groups.

Other Teaching Activities:

- Lecture notes for Math 242 - Multivariable and Vector Calculus.
- Lecture notes for Math 260 - Linear Algebra.
- Advisor for students with major or minor in Mathematics, UMass Boston, 2006 - present.
- Advisor for students with major in Engineering, Penn State Altoona, 2003 - 2005.
- Contributor to OpenCourseWare at UMass Boston: materials for Calculus I, II, and III.
- Course coordinator for Math 140 - Calculus I, 2008-2010.

Teaching Related Conferences and Workshops

- 14th Annual Legacy of R. L. Moore Conference, Washington, DC. Jun 2011
- UMass Boston Educational Technology Conference, Boston, MA. May 2011
Presentation: *Using WeBWork in Mathematics Instruction*
- 12th Annual Legacy of R. L. Moore Conference, Austin TX. Jul 2009
- CONNECT Math Conference, Massasoit Community College, MA. May 2009
“Essential Topics in Mathematics,”
- UMass Boston Educational Technology Conference, Boston, MA. May 2007
Panel presentation: *“Sharing Your Course with the Public (OpenCourseWare)”*
- 10th Annual Legacy of R. L. Moore Conference, Austin TX. Apr 2007
- Instructional Technology Conference, Sturbridge, MA. Apr 2007
“The Scholarship of Learning and Teaching: Technology and Reflective Practice.”
- COSMIC Seminar, Spring 2007 semester
- CIT’s Annual Conference, “Teaching for Transformation,” Boston, MA. Jan 2007
Panel Presentation: *“Mini-Lessons with Technology”*
- CIT Seminar, UMass Boston, Fall 2006 semester.
“Working with Technology in Our Courses: Pedagogical and Critical Perspectives,”
- Project NExT Workshops
Providence RI (August 2004), Phoenix AZ (January 2004), Boulder CO (July 2003)
- Section NExT Meetings, Allegheny Mountain MAA Section
Slippery Rock (March 2005), Pittsburgh (September 2004), Buckhannon (March 2004)
- PREP Workshop, Providence RI, June 2005
“Internet-Based Interactive Multivariable Calculus”
- 8th Annual Legacy of R. L. Moore Conference, Austin TX, April 2005.
- MAA Minicourse, Atlanta GA, January 2005
“ConceptTests and Peer Instruction: Active learning in the calculus classroom”
- 7th Annual Legacy of R. L. Moore Conference, Austin TX, March 2004.

Support:

- Program for Instruction Innovation Grant, UMass Boston, 2010
- Dean’s Development Fund Grant, Penn State Altoona, 2004-2005
- Travel Grant, Schreyer Institute for Teaching Excellence, Penn State University, 2005
- Travel Grants, Educational Advancement Foundation 2004, 2005, 2007, and 2009.
- AMS Project NExT Fellow Grant, AMS and Penn State Altoona, 2003-2004

Service

Department of Mathematics, UMass Boston

- Associate Chair, August 2010 - June 2012.
Assisted the Chair in the administration of the Department.
Focused on advising, transfer credit, graduation requirements.
- Curriculum Committee, Fall 2008 - Spring 2012. Chair, Fall 2009 - Spring 2011.
Developed and implemented the “Honors in Mathematics” award.
Developed and implemented an improved version of Math 242 - Multivariable Calculus.
Developed two advanced undergraduate courses:
Math 356 (Differential Geometry) and Math 454 (Analysis on Manifolds).
- Personnel Committee, Fall 2006 - Spring 2008, Fall 2011-Spring 2012
Participated in the annual review process for full-time and part-time faculty.
- Recruitment Committee, Fall 2006 - Spring 2012
Member, Search Committee for a Department Chair (2009-2010).
Member, Search Committee for tenure-track Assistant Professor positions (2007-2012).
Member, Search Committees for part-time faculty positions.
Member, Search Committees for administrative positions.
- Honors Committee, Spring 2010, Spring 2014.
- Course Coordinator for Math 140 - Calculus I, Fall 2008 - Spring 2010
Attended lectures by part-time instructors and provided evaluations.
Wrote common final exams.
- Web master for the departmental web site, Spring 2005 - present
Redesigned and maintained the departmental web site (www.math.umb.edu).
Developed and implemented online evaluation forms for Math 114Q.

College of Sciences and Mathematics, UMass Boston

- Chair, College Faculty Senate, Fall 2012 - present; member: Fall 2010-present
- Member, Litton and Brann Scholarships Selection Committee, 2013 - present
- Member, Student Success Task Force, Spring 2009
Served on two subcommittees: Learning Communities and Student Support Services
- Math Department representative, Orientation Sessions for CSM students, Summer 2010
Participated in several orientation sessions for incoming CSM students
- Acted as client for CS682/683 (Software Engineering), Fall 2006 - Spring 2007
Met frequently with, and provided feed-back to, a team of six CS M.S./Ph.D. students.

University of Massachusetts Boston

- Coach and local organizer for the William Lowell Putnam Competition, 2006-present
Prepared students through weekly problem solving sessions each fall semester.
The UMass Boston team ranked **21st** in 2011, **57th** in 2013, and **63rd** in 2010.
Received and processed registration forms and exams, administered 6-hour exams.
- Member, Academic Technology Committee, Fall 2011 - Spring 2014.
- Member, Campus Fellowship Committee, Fall 2011
Interview two students who were applying for Fulbright fellowships;
Assessed the student’s potential and offered constructive criticism.
The student recommended by the committee received a Fulbright scholarship.
- Member, Academic Dishonesty Panel, Fall 2011
Panel convened by the Associate Provost to hear the appeal of a graduate student

- Member, Academic Support Programs College Personnel Committee, Spring 2011
Reviewed one candidate for promotion to Senior Lecturer
- Member, Math Placement Tests work group, Spring - Fall 2010
Studied and discussed the development and implementation of revised Placement Tests
- Review Committee, Comprehensive Scholarships for Continuing Students, 2006-present.
Evaluated 200+ application packages: essay, recommendation letter, and transcript.
- Participant, UMass Boston Open House, Fall 2006, Fall 2008.
- Mathematics Faculty Work Group, Title III Grant, Spring 2009.
Participated in meetings with representatives of five community colleges.
Discussed methods to improve transfer student recruitment and retention.
- Member, Joint work group with Dorchester Academy High School, Summer 2010.
Discussed methods to better align curriculum and expectations with the goal of improving the success of students who take college math courses.
- Facilitator, the breakout session for CSM at the new faculty orientation, September 2010.
- Member, Advisory Board for Research Seminar For Pre-Tenured Faculty, Fall 2010 - Spring 2013.

Community

- Member, panel at OCW workshop for Boston public high school teachers, July 2010.
- “Transformations in Geometry” Presentation, Haitian Scientific Society, March 2007.
- Judge for the Undergraduate Poster Session, AMS-MAA Joint Meetings, 2004, 2005.
- Judge for the Pennsylvania Junior Academy of Science Competition, 2004, 2005.

Profession

- Reviewer for Mathematical Reviews. Reviewed 3 books and 42 articles.
- Referee for research journals and conference proceedings. Refereed 12 manuscripts.
- Member, Calculus Board of Advisors, Houghton Mifflin Company, 2003-2006.
Reviewed two chapters for a new calculus textbook under development.
Participated in Advisory Board meetings, Boston, October 2005.