Elisha Peterson

Assistant Professor/NRC Davies Fellow
Department of Mathematical Sciences
United States Military Academy

Work Address:
MADN-Math, United States Military Academy
646 Swift Road
West Point, NY 10996-1905
845.938.5649
elisha.peterson@usma.edu
http://www.dean.usma.edu/math/people/Peterson/

Home Address:
30 Broadway
Cornwall, NY 12518
845.534.2749; 845.337.6814 (cell)
http://elishapeterson.wikidot.com/

Education

- PhD Mathematics, University of Maryland, May 2006.
  - *Thesis:* "Trace Diagrams, Representations, and Low-Dimensional Topology." *Advisor:* Bill Goldman.
- Rhodes Scholar, Oxford University, 2000-2002.
  - *Field of Study:* knot theory, tangle surgery. *Advisor:* Marc Lackenby.
- BS Mathematics, Harvey Mudd College, 2000 (1st in class, 4.00 GPA).
  - *Thesis:* "Combinatorial Proofs of a Generalized Sperner's Lemma." *Advisor:* Francis Su.

Research Interests

- Trace diagrams and their applications to linear algebra, invariant theory, moduli spaces, character varieties, and geometric structures.
- Game theory and multi-agent systems, especially the mathematics of cooperation in the context of pursuit and evasion games.
- Combinatorics; applications of graph theory; Sperner's Lemma; fair division.
- Technology and visual aesthetics in the communication and teaching of mathematics.

Honors & Awards

- Best Category Paper Award & 3rd Best Paper Overall, Army Science Conference 2008.
- Army Research Office Research Travel Grant, 2008.
- Project NExT Fellow, 2007.
- National Research Council Davies Fellowship, 2007-present.
- USMA Dean's Junior Faculty Research Grant, 2007
- NSF Graduate Research Fellowship Award, 2002-2004.
- University of Maryland Department TA Award, 2003.
- Rhodes Scholar, 2000-2002.
- Outstanding Mathematics Thesis Award, Harvey Mudd College, 2000.
- Barry Goldwater Scholar, 1999-2000.
- Giovanni Mathematics Fellow (for scholastic distinction and research), HMC, 1999-2000.
- Sophomore Mathematics Award, HMC, 1998.
- Robert C. Byrd Scholar, 1996-2000.

Teaching Experience

- Assistant Professor/Davies Research Fellow, United States Military Academy, 2006-present.
  - Mathematical Modeling & an Introduction to Calculus, Fall 2006.
  - Differential Calculus, Spring 2006.
  - Advanced Multivariable Calculus, Fall 2008.
  - Real Analysis, Spring 2007.
  - Topology (independent study), Fall 2008.
- Teaching Assistant, University of Maryland, 2002-2006.
  - *Instructor*: Linear Algebra, Introduction to Probability.
  - *Teaching Assistant*: Calculus I, Calculus III, Linear Algebra, Differential Equations, Numerical Methods in Engineering.
- Completed USMA Master Teacher Program, 2006-2007.

Undergraduate Research Experiences

- Course Director for Math/OR Honors Thesis Program, AY2008 and AY2009.
- Course Director for Math/OR Capstone Program, AY2008.
- Advisor for Student Projects:
  - Paul Falcone '10: 3-*Trace Diagrams and Invariant Theory*
  - James Lee '09, honors thesis: *Trace Diagrams, Linear Algebra, and Invariant Theory*.
  - Lucas Gebhart '09, honors thesis: *Cooperation in Pursuit-Evasion Games*.
  - Daniel Ball '08, capstone paper: *Cooperative Linear Pursuit*.
  - Andrew Plucker '08, honors thesis: *Pursuit and Evasion Modeling: the Effect of Leading*.
  - Steve Morse '08, honors thesis: *Diagramming Linear Algebra: Some Results and Trivial Proofs*.

Scholarly Articles

- **Refereed Journal Articles**
  - "Using a Wiki to Enhance Cooperative Learning in a Real Analysis Course", to appear in *PRIMUS*, 19: 1-11, 2009.
  - "Spin Networks and SL(2,C) Character Varieties" (with Sean Lawton), to appear in the *Handbook of Teichmuller Theory Volume II*, 2008.
  - "A polytopal generalization of Sperner's Lemma" (with Francis Su & Jesus de Loera), *Journal of Combinatorial Theory Series A*, 100:1-26, 2002.
  - "Four-person envy-free chore division" (with Francis Su), *Mathematics Magazine*, 75: 117-122, 2002.
- **Conference Proceedings**
  - "Cooperation in Social Networks: Communication, Trust, and Selflessness" (with Chris Arney), Modeling/Simulation Category, *Proceedings of the 2008 Army Science Conference*. Won **Best Paper Award** in Modeling/Simulation Category; **3rd Best Paper Overall** (out of 845 submissions).
  - "A mathematical formalism for selfish and altruistic cooperation in social networks" (with Chris Arney), *USMA Network Science Report*, 2008.
- **Articles in Preparation**
  - "Computing SL(2,C) Central Functions with Spin Networks" (with Sean Lawton). *Generalizes earlier paper on SL(2,C) character varieties with techniques for computing all SL(2,C) central functions.*

- "Trace Diagrams, Determinants, and Some Trivial Proofs" (with undergraduate student Steven Morse). *Describes ways to represent the determinant using trace diagrams, including a new proof of a Jacobi theorem for matrices and the Dodgson condensation technique.*
- "Generalized Trace Diagram Recurrences and the Computation of nj-Symbols". *Describes a general technique that produces a recurrence formula for each closed loop in a trace diagram, with an application to the computation of nj-symbols.*
- "Trace Diagrams and the Invariant Theory of 2x2 Matrices" (with undergraduate student James Lee). *Describes how the invariant theory of 2x2 matrices arises neatly from trace diagrams.*

- **Unpublished & Expository Articles**
  - "Dynamic Cobwebbing with Geogebra" (online tutorial), available at http://elishapeterson.wikidot.com/technotes:geogebra-cobwebs.
  - "A Not-So-Characteristic Equation: the Art of Linear Algebra" (expository article), arXiv:0712.2058.

Software

- *Blaise*: an open-source Java platform for designing online mathlets, developing since 2007, available at http://blaisemath.googlecode.com; sample applets available on USMA webpage.
- *PEG*: a Java platform for analyzing pursuit and evasion games, developing since 2007, available at http://blaisemath.googlecode.com.
- Developed over 20 mathlets using Geogebra for multivariable calculus and real analysis, available at http://www.dean.usma.edu/departments/math/people/Peterson/geogebra/mathlets.html.

Talks

- **Invited and Noteworthy Talks**
  - "Trace Diagram Recurrences and Central Functions of SL(2,C)-Character Varieties, AMS Special Session on the Algebra, Geometry, and Topology of Character Varieties, JMM 2009, 8-Jan-09.
  - "Cooperation in Social Networks: Communication, Trust, and Selflessness", Advanced Modeling & Simulation Category, Army Science Conference, 2-Dec-08.
  - "Dynamic Mathematics and Pursuit/Evasion Games", USMA Department of Mathematics *Center for Faculty Development*, 20-Nov-08.
  - "Altruism and Selfish Cooperation in Social Networks", USMA Network Science Workshop, Oct-08 (invited).
  - "Social Network Optimization and Synergy in Cooperative Systems: Trust and Selflessness", USMA Network Science Workshop, Oct-07 (invited).
  - "Trace Diagrams, Spin Networks, and Spaces of Graphs" and "Diagrammatic Central Functions", mini-workshop at the 7th KAIST Geometric Topology Fair in Gyeongju, Korea, 10-Jul-07 (invited).
  - "Trace Diagrams, Surfaces, and Character Varieties", colloquium at Kansas State University, 15-Apr-07 (invited).
- **Contributed Talks**
  - "Java Mathlets with Blaise", MAA Session on Mathlets for Teaching and Learning Mathematics, JMM 2009, 7-Jan-09.
  - "PEG: Analyzing Metrics of Cooperation through Pursuit and Evasion Games", ARL-USMA Technical Symposium, Oct-08.
  - "Online Collaboration with a Wiki in Real Analysis", session on Creative Uses of Emerging Technologies for Mathematics Teaching, MathFest 2008, 1-Aug-08.
  - "Signed Graph Coloring, the Art of Linear Algebra, and a Theorem of Jacobi", MathFest 2008, 31-Jul-08.

- "The Character Variety's New Clothes", AMS Session on Algebra and Number Theory, JMM 2008, 7-Jan-08.
- "Visualizing Lagrange Multipliers: a Discovery Approach to Constrained Optimization", MAA session on Demos and Strategies with Technology that Enhance Teaching and Learning Mathematics, JMM 2008, 7-Jan-08.
- "Cooperating Teams in Pursuit & Evasion Games", ARL-USMA Technical Symposium, Oct-07.
- "The Art of Linear Algebra", USMA Math Department Research Seminar, 5-Dec-07.
- "Trace Diagrams, Surfaces, and Low-Dimensional Topology", PhD Defense, 25-Apr-06.

Professional Service

- Member of USMA selection committee for Rhodes, Marshall, & other scholarships, 2006-present.
- USMA Department of Mathematical Sciences Academic Counselor, 2007-present.
- Coordinator for USMA Department of Mathematical Sciences Problem-of-the-Week, 2007-2008.
- Coach (2007) and USMA co-organizer (2008) for the Mathematics Contest in Modeling
- USMA Projects Day 2008: organizer for Math/OR Poster Session.
- Co-organizer of AMS Session on "The Geometry, Algebra, and Topology of Character Varieties", JMM 2009.
- Co-organizer of Project NExT Session on "Computer Algebra Systems in the Classroom", MathFest 2008.
- Co-editor of *Mathematica Militaris* journal, 2008-2009.
- Referee for PRIMUS journal
- Referee for Army Research Office grant proposals.

Prior Work Experience

- Cryptologic Mathematician, Director's Summer Program, NSA, Ft. Meade, MD.
  - Summer 2000: worked on a problem involving signals processing; wrote paper and presented results with team.
  - Summer 1999: worked on a problem involving signals processing, probability, and statistics; wrote paper and presented results in organization-level seminar.
- Research Assistant, Harvey Mudd College, Claremont, CA. Advisor: Francis Su.
  - Summer 1998: investigated fair division of goods, chore division and rent partitioning; wrote a paper on several new chore division algorithms discovered; began proof of a generalization of Sperner's Lemma later published in JCT-A.

Skills & Interests

- **Mathematics software**: Mathematica, Matlab, Maple, Geogebra.
- **LaTeX**: PGF/TikZ, Beamer, Metafont, xfig, WinEdt.
- **Programming**: Java, Netbeans, C/C++, HTML/CSS/XML, SVG.
- **Notable creative skills**: writing, photography, media design, video production.
- **Athletic experiences**: Oxford University "Full Blue" (cross country and track & field); Magdalen College Boat Club (rowing); Claremont-Mudd Scripps all-conference/all-region/academic all-American (cross country and track & field); marathon runner and triathlete.
- **Other interests**: triathlons, juggling, traveling, web2.0/3.0, building almost anything.