Maria Emelianenko

Contact Information

Science & Tech I, 226A
Department of Mathematical Sciences
George Mason University
Fairfax, VA 22030 USA

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Research Interests

Numerical methods and applied PDE, modeling of nonlinear systems, multigrid methods, optimization, stochastic processes, applications to materials science, physics and biology

Positions

George Mason University, Fairfax, Virginia, USA
Assistant Professor, Department of Mathematical Sciences 08/2007 - present
Affiliate Faculty, Computational Materials Science Center

Carnegie Mellon University, Pittsburgh, Pennsylvania, USA
CNA Postdoctoral Research Associate, Center for Nonlinear Analysis 08/2005 - 08/2007

Pennsylvania State University, University Park, Pennsylvania, USA
Research Assistant, Mathematics Department 2003 - 2005
Teaching Assistant/Associate, Mathematics Department 1999 - 2005

Education

Pennsylvania State University, University Park, Pennsylvania, USA
Department of Mathematics

Ph.D. Mathematics, Minor in High Performance Computing 08/2005

Thesis: "Multilevel and Adaptive Methods for Some Nonlinear Optimization Problems"
Advisor: Prof. Qiang Du

M.A. Mathematics 08/2002

Thesis: "Analysis of Constrained Multidimensional Birth-Death Processes"
Advisor: Prof. N. Gautam

Moscow State University, Moscow, Russia
Department of Computational Mathematics and Cybernetics

M.S. Applied Mathematics, *summa cum laude* 06/2001

Thesis: "Numerical approach to solving Andronov-Hopf and Bogdanov-Takkens systems of differential equations"
Advisor: Prof. A. Bratus

B.S. Computer Science/Math, *summa cum laude* 06/1999

Honors and Awards

PI, NSF CAREER grant, Computational Mathematics, $452,009,	2011-2016
PI, AWM Sonia Kovalevsky Day grant, $1795,	2011
PI, NSF grant, Computational Mathematics, $267,000,	2009-2012
ORAU's Ralph E. Powe Junior Faculty Enhancement Award	2009-2010
co-PI, NSF grant for establishing REU site at GMU, $180,000	2009-2010
Project NExT Fellow (nation-wide competition)	2008-2009
Research Award, GMU (university-wide competitive grant)	06/2008
First Place in Poster Competition, Gordon Research conference on Physical Metallurgy	07/2006
Travel Award, Gordon Research conference on Physical Metallurgy	07/2006
Dean's Recognition for Outstanding Teaching, CMU	2005
SIAM Student Travel Award, SIAM Meeting, New Orleans	07/2005
Honorable Mention in Student Paper Competition, Copper Mountain Conference	04/2005
Graduate Assistant Outstanding Teaching Award Nomination, PSU	2004
Graduate School Teaching Certificate, PSU	2004

Teaching with Technology Certificate, PSU	2004
Teaching Associate Certificate, Department of Mathematics, PSU	2003
Davey Fellowship, Department of Mathematics, PSU	2003
Applied Management Principles Certificate, Purdue University	2002
Eberly College of Science Fellowship, PSU	1999
Moscow City Mayor's stipend for Distinguished Students, Moscow State University	1998
Dean's List, Moscow State University	1996-1999
Dubna Foundation of Science and Education Scholarship	1995-1996
Highest Distinction ("'Gold Medal"') on graduation from high school	1996

PUBLICATIONS

21. Z. Di, M. Emelianenko, S. Nash, *"Truncated Newton-based multigrid algorithm for centroidal Voronoi calculation"*, to appear in Numer. Math. Theor. Meth. Appl., 2011

20. J. Bode, A. Baranova, G. Manyam, M. Emelianenko, *"A tree-based algorithm for systematic analysis of polynucleotide sequences"*, to appear in BMC Research Notes, 2011

19. K. Barmak, E. Eggeling, M. Emelianenko, Y. Epshteyn, D. Kinderlehrer, R. Sharp, S. Ta'asan *"An entropy based theory of the grain boundary character distribution"*, Phys. Rev. B, **83**, no. 13, p.134117 (2011)

18. K. Barmak, E. Eggeling, M. Emelianenko, Y. Epshteyn, D. Kinderlehrer, R. Sharp, S. Ta'asan, *"Critical events, entropy, and the grain boundary character distribution"*, DCDS-A, **30**, no. 2 (2011), p.427–454

17. M. Atkins (mentors: D. Anderson, M. Emelianenko, Y.Mishin), "A Method of Calculating the Thickness of a Solid-Liquid Interface", SIAM Undergraduate Research Online, **3**, 2010

16. K. Barmak, E. Eggeling, M. Emelianenko, Y. Epshteyn, D. Kinderlehrer, R.Sharp, and S.Ta'asan, *"Predictive theory for the grain boundary character distribution"*, in Proc. Recrystallization and Grain Growth IV, 2010.

15. M. Emelianenko, *"Fast Multilevel CVT-based Adaptive Data Visualization Algorithm"*, Numer. Math. Theor. Meth. Appl., **3**, No. 2 (2010), p.195-211

14. K. Barmak, E. Eggeling, M. Emelianenko, Y. Epshteyn, D. Kinderlehrer, S. Ta'asan, *"Geometric growth and character development in large metastable systems"*, Rendiconti di Matematica, Serie VII, **29**, Roma (2009), p.65–81

13. K. Barmak, M. Emelianenko, D. Golovaty, D. Kinderlehrer, and S. Ta'asan., *"A new perspective on texture evolution"*, Intl. J. of Num. Anal. and Modeling, **5**, Supp (Special Issue on Modeling, Analysis and Simulations of Multiscale Nonlinear Systems), 2008, p.93–108

12. K. Barmak, M. Emelianenko, D. Golovaty, D. Kinderlehrer, S. Ta'asan, *"Towards a statistical theory of texture evolution in polycrystals"*, SIAM J. Sci. Comput., **30** No. 6 (2008), p. 3150–3169

11. M. Emelianenko, L. Ju, A. Rand, *"Nondegeneracy and weak global convergence of the Lloyd algorithm in* $\mathbb{R}^d$*"*, SIAM J. Numer. Anal., **46** Issue 3 (2008), p.1423–1441

10. Q. Du, M. Emelianenko *"Uniform convergence of a nonlinear energy-based multilevel quantization scheme via centroidal Voronoi tessellations"*, SIAM J. Numer. Anal., **46**, Issue 3 (2008), p. 1483–1502

9. K. Barmak, M. Emelianenko, D. Golovaty, D. Kinderlehrer, and S. Ta'asan., *"On a statistical theory of critical events in microstructural evolution"*, Proc. of the 11th International Symposium

on Continuum Models and Discrete Systems (CMDS11), Paris, France, 2007

8. Q. Du, M. Emelianenko and L. Ju *"Convergence properties of the Lloyd algorithm for computing the centroidal Voronoi tessellations"*, SIAM J. Numer. Anal., **44**, Issue 1 (2006), p. 102–119

7. M. Emelianenko, Z.-K. Liu, Q. Du *"A New Algorithm for the Automation of Phase Diagram Calculation"*, Comp. Mater. Sci., **35**, Issue 1 (2006), 61-74
[In ScienceDirect Top 25 Hottest Articles]

6. Q. Du, M. Emelianenko *"Acceleration schemes for computing the centroidal Voronoi tessellations"*, Numer. Linear Algebra Appl., **13**, Issue 2-3 (Special Issue on Multigrid Methods) (2006), p. 173–192

5. Q. Du, M. Emelianenko, H.-C. Lee and X. Wang *"Ideal point distributions, best mode selections and optimal spatial partitions via centroidal Voronoi tessellations"*, Proc. 2nd Intl. Symp. on Voronoi Diagrams in Sci. and Engr., Seoul, Korea, Oct 2005 (VD2005), pp. 325-333, 2005

4. Q. Du, M. Emelianenko *"A multilevel energy-based quantization scheme"*, Lecture Notes in Comp. Sci. Eng., **55**, Widlund, Olof B.; Keyes, David E. (Eds.), Springer, Berlin (2007), p.533–541

3. M. Yacoubi, M. Emelianenko and N. Gautam *"Pricing in next generation network queuing model to guarantee QoS"*, Perform. Evaluation, **5**, issue 1 (2003), 59-84
[In Top 10 downloads from Performance Evaluation website in 2003]

2. E.B. Dushanov, M.G. Emelianenko and G.Yu. Konovalova *"On formats of the representation of real numbers and algorithm for automatic declaration of constants of the computer real arithmetic"*, J. Comput. Meth. Sci. Eng., **2**, issue 1-2 (2002), p.57–62

1. G.A. Emelyanenko, V.N. Samoilov and M.G. Emelianenko *"The uncertainty principle in numerical linear algebra"*, in Proc. Intl. Conf. on Comp. Math. Part I-II, (2002), 104–106, ICMMG, Novosibirsk

Books

M. Emelianenko, "Multilevel and adaptive methods for nonlinear optimization problems", VDM-Verlag, ISBN 978-3-639-22436-8, 2010

Publications on education

M. Emelianenko, *"Helping Undergraduates See Mathematics in Material World"*, SIAM News, **43**, Number 6, 2010

Preprints

6. Katayun Barmak, E. Eggeling, Maria Emelianenko, Yekaterina Epshteyn, David Kinderlehrer, Richard Sharp, Shlomo Ta'asan, *An Entropy Based Theory of the Grain Boundary Character Distribution*, Center for Nonlinear Analysis, No. 11-CNA-001, 2011

5. Katayun Barmak, E. Eggeling, Maria Emelianenko, Yekaterina Epshteyn, David Kinderlehrer, Richard Sharp, *Critical Events, Entropy, and the Grain Boundary Character Distribution*, Center for Nonlinear Analysis, No. 10-CNA-014, 2010

4. Katayun Barmak, E. Eggeling, Maria Emelianenko, Yekaterina Epshteyn, David Kinderlehrer, Richard Sharp, Shlomo Ta'asan, *Predictive Theory for the Grain Boundary Character Distribution*, Center for Nonlinear Analysis, No. 10-CNA-013, 2010

3. M. Emelianenko, D. Golovaty, D. Kinderlehrer, S. Ta'asan, *Texture evolution via continuous time random walk theory*, Center for Nonlinear Analysis, No. 06-CNA-011, 2006

2. M. Emelianenko, D. Golovaty, D. Kinderlehrer, S. Ta'asan, *Grain boundary evolution: new*

perspectives, Center for Nonlinear Analysis, No. 06-CNA-010, 2006

1. G.A. Emel'yanenko, M. Emelianenko, T.T. Rakhmonov, E.B. Dushanov, G.Yu. Konovalova, *On efficiency of critical-component method for solving singular and ill-posed systems of linear algebraic equations*, preprint JINR, Dubna, Russia, arXiv:math/0108074, 2001

Papers in preparation

1. *"Automation of high-dimensional phase diagram calculation"*, with T. Stephens, S. Varela, R. Hill, I. Griva, A. Davydov

2. *"Inactivation of oxidative catalysts. A mathematical approach"*, with A. Ryabov

3. *"Markov processes in microstructure evolution"*, with H. de Silva

Presentations

- "A mathematician's journey and what really matters", invited talk, PSU SIAM Chapter, University Park, PA May 16, 2011
- "Stochastic and kinetic approaches in mesoscale modeling of grain growth in polycrystalline materials", minisymposium talk, SIAM AN10, Pittsburgh, PA, July 12-16, 2010
- "Towards a Unified Statistical Theory of Texture Evolution in Polycrystals", minisymposium talk, SIAM MS10, Philadelphia, PA, May 23-26, 2010
- "Fast Multilevel CVT-based Adaptive Data Visualization Algorithm", invited talk, CS department, GMU, April 13, 2010
- "Kinetic Approaches in Mesoscale Modeling of Polycrystals", minisymposium talk, SIAM PD09, Miami, FL, Dec 8, 2009
- "Mesoscale theory of texture evolution in polycrystals", invited talk, Applied Math colloquium, UMBC, Dec. 4, 2009
- "Mesoscale modeling of materials microstructure", invited talk, Applied Math seminar, University of Delaware, Oct. 27, 2009
- "Kinetic Theories in Multiscale Modeling of Polycrystals", invited talk, Multiscale Modeling and Simulation of Materials minisymposium, SIAM-SEAS Annual Meeting, U. South Carolina, April 4, 2009
- "Kinetic Theories in Multiscale Modeling of Polycrystals", invited talk, FRG workshop on Kinetic Description of Multiscale Phenomena: Modeling, Theory and Computation, U. of Maryland, College Park, March 4, 2009
- "Nonlinear dynamical phenomena in mesoscale modeling of polycrystals", special session presentation, AMS Annual meeting, Washington, DC, Jan 8, 2009
- "Texture evolution: new perspectives", poster presentation, 4th Intl. Multiscale Materials Modeling conference, Florida State University, Tallahassee, FL, Oct 27-31, 2008
- "Voronoi diagrams, quantization and clustering: theory and applications", invited colloquium talk, George Mason University, Fairfax, VA, Oct 17, 2008
- "Understanding stochastic events in microstructure evolution", invited colloquium talk, Georgetown University, Washington, DC, Oct 3, 2008
- "Understanding stochastic events in microstructure evolution", invited talk, PDE seminar, U. Maryland, College Park, Oct 2, 2008
- "Voronoi-Based Binning Techniques: Acceleration Methods and Applications", minisymposium talk, SIAM Annual Meeting, San Diego, July 2008
- "PDE approach to mesoscale modeling and control of materials microstructure", special session presentation, Pontryagin conference, Moscow State University, Moscow, Russia, June 17, 2008

- "Mesoscale modeling of polycrystals: interplay of theory and simulation", invited talk, SIAM MS08, Minisymposium on Grain Boundary Evolution, May 11, 2008
- "Understanding stochastic events in microstructure evolution", Research Coloquium in Computational Materials Science, GMU, April 14, 2008
- "Mesoscale modeling of polycrystals: understanding stochastic events in microstructure evolution", Applied Mathematics seminar, GWU, April 10, 2008
- Keynote speaker, annual PSU Graduate Open House/Alumni Conference, March 29, 2008
- "Crossing boundaries and shaping the world: interdisciplinary math approach", Women In Scientific DOMains meeting, GMU, Dec. 4, 2007
- "On a statistical theory of critical events in miscrostructure evolution", Math Department Colloquium, Florida State University, Nov. 9, 2007
- "Microstructure Evolution: Recent Progress and Open Questions", Applied Math seminar series, GMU, Sept. 21, 2007
- "On a statistical theory of critical events in miscrostructure evolution", Computational & Data Sciences Colloquium, GMU, Sept. 20, 2007
- "Mathematical modeling and simulation of texture evolution", poster presentation, Barrett Lectures, U. Tennessee, Knoxville, TN, April 29-30, 2007
- "Centroidal Voronoi tessellations: concepts and applications", Undergraduate Colloquium series, CMU, Pittsburgh, PA, April 12, 2007
- "Texture evolution: mathematical aspects", MIMP Seminar, MRSEC, CMU, Pittsburgh, PA, March 27, 2007
- "Toward a Statistical Theory of Texture Evolution", contributed talk, SIAM CSE07, Costa Mesa, CA, February 19-23, 2007
- "Multidimensional Energy-based Multilevel Quantization Scheme and its Applications", invited talk, SIAM CSE07, Costa Mesa, CA, February 19-23, 2007
- "Centroidal Voronoi tessellations: theory and applications", invited talk, CSUCI, Camarillo, CA, Feb 16, 2007
- "Mathematical modeling and simulation of texture evolution", invited talk, US Naval Academy, Anapolis, MD, Feb 9, 2007
- "Mathematical modeling and simulation of texture evolution", invited talk, Clarkson Univ., Potsdam, NY, Feb 5, 2007
- "Mathematical modeling and simulation of texture evolution", invited talk, American Univ., Washington, DC, Feb 2, 2007
- "Mathematical modeling and simulation of texture evolution", invited talk, Purdue Univ., West Lafayette, IN, Jan 31, 2007
- "Mathematical modeling and simulation of texture evolution", invited talk, U. Tennessee, Knoxville, TN, Jan 29, 2007
- "Mathematical modeling and simulation of texture evolution", invited talk, George Mason Univ., Fairfax, VA, Jan 26, 2007
- "Mathematical modeling and simulation of texture evolution", invited talk, Illinois Inst. Tech., Chicago, IL, Jan 22, 2007
- "Mathematical modeling and simulation of texture evolution", invited talk, U. Minnesota, Minneapolis, MN, Jan 19, 2007
- "Mathematical modeling and simulation of texture evolution", contributed talk, Joint AMS Meetings, Jan 4-8, 2007

· "Mathematical modeling and simulation of texture evolution", invited talk, U. Akron, Akron, OH, Dec 13, 2006

· "Mathematical modeling and simulation of texture evolution", invited talk, U. Pittsburgh, Pittsburgh, PA, Dec 5, 2006

· "Mathematical Modeling and Simulation of Texture Evolution", invited presentation, A Conference on Applied Analysis on the Occasion of the 65th Birthday of David Kinderlehrer, CNA, CMU, Pittsburgh, PA, Oct 19 - 21, 2006

· "Mathematical modeling and simulation of the grain boundary character distribution", invited poster presentation, Gordon Research Conference on Physical Metallurgy, Plymouth, NH, July 23-28, 2006

· "Uniform convergence of a nonlinear energy-based multilevel quantization scheme via centroidal Voronoi tesselations", invited presentation, Joint MAA-SIAM Meeting, Auburn, AL, March 31-April 2, 2006

· "A nonlinear energy-based multilevel quantization scheme", invited presentation, Frontiers in Nonlinear Analysis, CNA, CMU, Pittsburgh, Sept 8-10 ,2005

· "Uniform convergence of a multilevel energy-based quantization scheme", invited presentation, Minisymposium on centroidal Voronoi tessellations, New Orleans, July 11-15 ,2005

· "A Nonlinear Energy-based Multilevel Quantization Scheme", invited presentation, XII Copper Mountain Conference on Multigrid Methods, Colorado, April 3-8, 2005

· "A New Algorithm for the Automation of Phase Diagram Calculation", invited talk, MCSD Seminar Series, NIST, Gaithersburg, MD, March 22, 2005

· "Uniform convergence of a multigrid energy-based quantization scheme", poster presentation, IMA Workshop: Career Options for Women in Mathematics, Univ. of Minnesota, Minneapolis, MN, February 4-5, 2005

· "Uniform Convergence of a Multigrid Enrgy-based Quantization Scheme", poster presentation, 16th International Conference on DDM, Courant Institute, January 12-15, 2005

· "A New Algorithm for the Automation of Phase Diagram Calculation", poster presentation, NSF Division of Materials Research ITR Computational Workshop, UIUC, Urbana, IL, June 17-19, 2004

Professional activities

· Conference organization:

· member of the Organizing committee, SIAM Conference on Mathematical Aspects of Materials Science (MS10), Philadelphia, PA, May 23 - 26, 2010

· co-organizer, "Grain Boundary Motion" minisymposium at 2010 SIAM Conference on Mathematical Aspects of Materials Science (MS10), Philadelphia, PA, May 23 - 26, 2010

· organizer, "Undergraduate Research in Mathematics of Materials" minisymposium at 2010 SIAM Conference on Mathematical Aspects of Materials Science (MS10), Philadelphia, PA, May 23 - 26, 2010

· co-organizer, "Kinetic Approaches in Materials Science" minisymposium for 2009 SIAM Conference on Analysis of PDEs, Miami, FL, Dec. 7-10, 2009

· co-organizer, "Recent Advances in Algorithms and Applications of Centroidal Voronoi Tessellation and Optimal Quantization" minisymposium for 2008 SIAM Annual Meeting, San Diego, CA,July 7-11, 2008

· co-organizer, "Grain Boundary Evolution" minisymposium for SIAM Conference on Mathematical Aspects of Materials Science(MS08), Philadelphia on May 11–14, 2008

· co-organizer, "Centroidal Voronoi Tessellations: Theory, Algorithms and Applications" minisymposium for SIAM Workshop on Combinatorial Scientific Computing (CSC07), Costa Mesa, CA, Feb 17–19, 2007

- Refereeing:
  Model. and Simulation in Mater. Sci. and Engr., CALPHAD, Intl. J. Num. Methods in Fluids, Mathematical Reviews, Pattern Recognition, Trans. Visualization and Comp. Graphics, SIAM Multiscale Modeling and Simulation, J. of Computational Physics
- Undergraduate research activities:
  Co-Director, GMU Multidisciplinary REU Program in Computational Mathematics and Nonlinear Dynamics of Biological, Bio-inspired and Engineering Systems, 2009 - present
  Faculty Participant, Computational Science Training for Undergraduates in the Mathematical Sciences (CSUMS), GMU, 2008 - present
  Summer Undergraduate Applied Math Institute, CMU, May 30 – July 17, 2007
- Diversity programs:
  co-Director, Sonia Kovalevsky High School Mathematics Day, GMU, May 2011
  Faculty member, Women in Scientific DOMains, GMU 2007–present
  Panelist, Women in Science group, CMU 2006
  Member, Women of Mathematics group, PSU 2000–2005
  Sponsored participant, "Career Options for Women in Mathematics" workshop, IMA, Minneapolis, Feb 4-5, 2005
- Professional memberships:
  Affiliate faculty, Center for Computational Materials Science (CMaSC)
  Associate, Computational Materials Science Network (CMSN)
  Societies: SIAM, AMS, AWM, MAA.
- Committee work:
  AWM SIAM Workshop Committee, 2010 - 2013
  GMU Nominations Committee, 2009 -
  GMU COS IT Planning Committee, 2009 -

CURRENT STUDENTS

Russell Mahoney, CSUMS undergraduate student, 2010-2011
Robert Hill, CSUMS undergraduate student (co-advised with I. Griva), 2010-2011
Boris Gafurov, GMU, Math, postdoc
Jeff Snider, GMU, Math, graduate student
Hasitha de Silva, GMU, Math, graduate student
Zichao Di, GMU, Math, graduate student (co-advised with S. Nash)
Jonathan Bode, GMU, Math, graduate student (co-advised with A. Baranova)
Ganga P. Purja Pun, GMU, Physical Sciences, Ph.D. thesis committee member

PAST STUDENTS

Sandra Varela (CSU Sacramento), GMU, REU student, Summer 2010
Ross Kistler (Loyola University of Maryland), GMU, REU student, Summer 2010
Jieun Lee, GWU, Mathematics, Ph.D. thesis committee, defended May 2010
Tom Stephens, GMU, Math, undergraduate student, 2009-2010
Joshua Snyder, GMU, CSUMS undergraduate student, 2008-2009
Angela Dapolite, GMU, REU, senior thesis at Clarkson, 2009-2010
Charles Cook (Alma College), GMU, REU student, Summer 2009
Tom Stephens, GMU, Math, CSUMS undergraduate student, 2008-2009
Mike Atkins, GMU, Math, CSUMS undergraduate student, 2008-2009
TJ Flynn, GMU, M.S. thesis committee, Spring 2009
Hye Young Na, GMU, CDS/Math, undergraduate student, Spring 2008
Mary Ann Graham, GMU, M.S. thesis committee, Fall 2007
Tarek Elgindi (University of Wisconsin), REU student, CMU, Summer 2007
Morgan Shaffer (Mount Holoyoke College), REU student, CMU, Summer 2007
Michelle Baker (Shippensburg University), REU student, CMU, Summer 2007
Jian Wang (UT Knoxville), REU student, CMU, Summer 2007

Keith Rogers (Alabama State), REU student, CMU, Summer 2007
Alexander Chun (Northwestern University), REU student, CMU, Summer 2007