Curriculum Vitæ

Valeria Barra

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Research Interests

Computational Mathematics, Computational Geometry, Numerical methods for Scientific Computing, Numerical Analysis, Discrete Differential Geometry, Computer Graphics, Computer Aided Geometric Design, CFD

Appointments

- *PostDoctoral Research Associate* *(June 2018–present)*
  University of Colorado at Boulder, CO, USA
  Research project in High Performance Scientific Computing. Involved in the development of an efficient, extensible, portable mathematical library (libCEED) for higher order finite element or spectral element methods. This project is developed under the supervision of Jed Brown within the Center for Efficient Exascale Discretization (CEED) of the Exascale Computing Project (ECP): a collaborative effort of the Office of Science (OOS) and the National Nuclear Security Administration (NNSA) of the Department of Energy (DOE).

Education

- *PhD in Applied Mathematics* *(September 2012–May 2018)*
  New Jersey Institute of Technology, Newark, NJ, USA (joint program with Rutgers University)
  PhD dissertation in computational fluid dynamics (CFD) titled *Numerical Simulations of Thin Viscoelastic Films*. Conducted novel numerical simulations of the dynamics of 2D and 3D thin viscoelastic liquid films, both at nanoscale and macroscale, using finite difference and finite element methods for grid-based, structured or unstructured meshes. Advisor: Shahriar Afkhami. Co-advisors: Lou Kondic and Shawn A. Chester
- *Master of Science in Mathematics* *(October 2008–February 2011)*
  Università degli Studi di Siena, Siena, Italy
  Master's thesis on Catmull-Clark subdivision surfaces. Independently designed and developed a code for both closed and open subdivision surfaces
- *Bachelor of Science in Mathematics* *(October 2005–December 2008)*
  Università degli Studi di Siena, Siena, Italy

Publications

- V. Barra, S. Afkhami, L. Kondic, *Thin viscoelastic dewetting films of Jeffreys type subjected to gravity and substrate interactions,* in revision for **The European Physical Journal E**, **(2018)**
- V. Barra, S. A. Chester, S. Afkhami, *Numerical simulations of nearly incompressible viscoelastic membranes,* **Computers & Fluids**, **175**, **(2018)**, doi: https://doi.org/10.1016/j.compfluid.2018.07.023
- V. Barra, *Numerical Simulations of Thin Viscoelastic Films*, PhD dissertation, **New Jersey Institute of Technology**, **(2018)**, url: https://digitalcommons.njit.edu/dissertations/1364
- V. Barra, S. Afkhami, L. Kondic, *Interfacial dynamics of thin viscoelastic films and drops,* **Journal of Non-Newtonian Fluid Mechanics**, **237**, **(2016)**, doi: http://dx.doi.org/10.1016/j.jnnfm.2016.10.001

Seminars / Invited Talks

- *Numerical investigation of thin viscoelastic films and membranes* *(October 22, 2018)*

Department of Mathematics, Colorado State University, Fort Collins, CO

- *Simulations of viscous fluids on curved surfaces* *(January 30, 2017)*
  Fluid Mechanics and Waves Seminar, Department of Mathematical Sciences, NJIT, Newark, NJ
- *Simulations of fluids on surfaces* *(December 13, 2016)*
  Research Seminar, **Pixar Animation Studios**, Emeryville, CA

CONTRIBUTED TALKS

1. *The problem of freezing of copper water heat pipes* *(June 29, 2018)*
   For **NASA Jet Propulsion Laboratory**
   Thirty-Fourth Annual Workshop on Mathematical Problems in Industry, Claremont, CA
2. *Numerical simulations of thin viscoelastic films* *(January 12, 2018)*
   AMS Joint Mathematics Meeting, San Diego, CA
3. *Numerical study of Thin viscoelastic films* *(July 7, 2017)*
   Department of Mathematical Sciences, NJIT, Newark, NJ
4. *Numerical study of thin viscoelastic films and drops* *(July 18, 2016)*
   Department of Mathematical Sciences, NJIT, Newark, NJ
5. *Wetting and dewetting of thin viscoelastic drops* *(July 15, 2016)*
   SIAM Annual Meeting, Boston, MA
6. *Interfacial dynamics of thin viscoelastic films and drops* *(April 20, 2016)*
   The Dana Knox Research Showcase, NJIT, Newark, NJ
7. *Interfacial dynamics of thin viscoelastic films and drops* *(January 15, 2016)*
   The Fifth Annual Northeast Complex Fluids and Soft Matter Workshop, NYU Tandon School of Engineering, New York, NY
8. *Analysis and simulations of a thin film of viscoelastic fluid* *(June 18, 2015)*
   Department of Mathematical Sciences, NJIT, Newark, NJ
9. *Analysis and simulations for interfacial instability of thin viscoelastic liquid films* *(January 16, 2015)*
   The Third Annual Northeast Complex Fluids and Soft Matter Workshop, NJIT, Newark, NJ
10. *Analysis and simulations of a thin film of viscoelastic fluid* *(July 10, 2014)*
    Department of Mathematical Sciences, NJIT, Newark, NJ

POSTERS

1. *Gravity-driven instabilities of thin viscoelastic films on an inverted plane* *(June 24–25, 2017)*
   NSF Capstone Laboratory Project
   Frontiers in Applied and Computational Mathematics 2017, NJIT, Newark, NJ
2. *Surface instabilities and droplets formation in thin viscoelastic films* *(October 28, 2015)*
   Graduate Students Research Day 2015, NJIT, Newark, NJ
3. *Numerical study of thin layers of viscoelastic fluids* *(October 16–18, 2015)*
   Scientista Symposium, **Microsoft**, New York, NY
4. *Numerical study of thin viscoelastic films on substrates* *(June 5–6, 2015)*
   Frontiers in Applied and Computational Mathematics 2015, NJIT, Newark, NJ
5. *Numerical study of thin viscoelastic films on substrates* *(March 14–18, 2015)*
   SIAM Conference on Computational Science and Engineering, Salt Lake City, UT
6. *Interfacial instability of thin viscoelastic liquid films* *(October 30, 2014)*
   Graduate Students Research Day 2014, NJIT, Newark, NJ
7. *Linear stability analysis of thin viscoelastic liquid of Jeffreys type with van der Waals interaction* *(May 22–23, 2014)*

Frontiers in Applied and Computational Mathematics 2014, NJIT, Newark, NJ

RESEARCH WORKSHOPS

- *Mathematical Problems in Industry, Claremont Graduate University, Claremont, CA* *(June 25–29, 2018)*
  NASA Jet Propulsion Laboratory
  The problem of freezing of copper water heat pipes (Technical Report)
  Three-phase thermodynamics problem to assess failing mechanisms of water-copper heat pipes in space
- *Mathematical Problems in Industry, NJIT, Newark, NJ* *(June 19–23, 2017)*
  Revon Systems, Incorporated
  Predicting exacerbation and associated triage in COPD patients (Executive Summary)
  Data science / machine learning project to predict COPD patience exacerbations
- *Mathematical Problems in Industry, Duke University, Durham, NC* *(June 13–17, 2016)*
  CoVar Applied Technologies
  Scoring practices for remote sensing (Technical Report)
  Evaluating algorithms for remote sensing of land mines
- *Mathematical Problems in Industry, University of Delaware, Newark, DE* *(June 22–26, 2015)*
  Corning, Incorporated
  Frozen shapes: thin nearly flat elastic shells with stretching and bending (Technical Report)
  Numerical simulations of a solid thermomechanics problem for elastic media
- *Mathematical Problems in Industry, NJIT, Newark, NJ* *(June 23–27, 2014)*
  W.L. Gore & Associates
  Characterization of porous media using a geometric depiction of fibrous materials (Executive Summary)
  Numerical implementation of a 3D network for fibrous media analysis and design
- *Graduate Students Mathematical Modeling Camp, Rensselaer Polytechnic Institute, Troy, NY* *(June 17–20, 2014)*
  A smooth ride on a bumpy road (Technical Report)
  Mathematical modeling and numerical investigation of the dynamics of vehicles driving on washboard roads

HONORS AND AWARDS

- *SIAM Early Career Travel Award* *(September 28, 2018)*
  Awarded travel funds from the U.S. National Science Foundation (NSF) to attend the 2019 SIAM Conference on Computational Science and Engineering (CSE19)
- *Ahluwalia Doctoral Fellowship Award* *(December 14, 2017)*
  Nominated for the outstanding academic performance and excellent research in the PhD Program in the Department of Mathematical Sciences, NJIT, Newark, NJ
- *Program for Excellence in Science of the American Association for the Advancement of Science* *(Spring 2015–Spring 2018)*
  Nominated among deserving graduate students by the Vice Provost for Graduate Studies, NJIT, Newark, NJ
- *Best Research Poster Award* *(October 30, 2014)*
  Best research poster for the Department of Mathematical Sciences, Graduate Students Research Day 2014, NJIT, Newark, NJ
- *University of Siena Mobility Fellowship* *(Fall 2011–Spring 2012)*
  Selected from over 80 candidates to receive full funding to spend two semesters at the New Jersey Institute of Technology, Newark, NJ, for education and research
- *Summa cum Laude Honor* *(February 09, 2011)*

Awarded the honor for the Master degree in Mathematical Sciences from the University of Siena, graduating with GPA 110/110 *summa cum laude*

Press Coverage

New Jersey Institute of Technology NEWS, "Finding Valeria: A Ph.D. Story" *(January 5, 2017)*

Industry Experience

Pixar Animation Studios, Emeryville, CA, USA *(Fall 2016)*
Research Intern
Developed a proprietary C++ library for a 2D Navier-Stokes solver for viscous fluid simulations on surfaces with arbitrary curvature. Expanded existing code to include different types of discretized domains (from triangular to polygonal meshes). Included user-defined solid obstacle and boundary conditions for open meshes. Prototyped the development of a plug-in for third-party procedural 3D animation and special effects software for film and entertainment, Houdini by SideFX. Developed a proprietary C++ library to simulate the dynamics and interface instabilities of 3D thin viscous films on triangulated surfaces with arbitrary curvature

Tecnoprogram Srl, Siena, Italy *(Spring 2011)*
Algorithm Analyst and Developer
Developed software for CAD/CAM systems. Analyzed geometry processing algorithms for applications in the fields of Computer Graphics, Numerically Controlled Machines and industrial robots, such as construction and modelling of NURBS surfaces, mesh triangulations, object trimming and surface reconstruction. Used geometric processing tools and libraries for large geometric databases, such as OpenMesh, and improved the performance of existing proprietary software

Teaching Experience

Graduate Courses

Spring 2018
MATH 614 – Numerical Methods I
TA, NJIT

Fall 2015
MATH 599 – Teaching in Mathematics
Lab Instructor, NJIT

Undergraduate Courses

Fall 2017
MATH 337 – 017 Linear Algebra
Instructor, NJIT

Spring 2017
MATH 451 – NSF Capstone Laboratory
Lab Instructor, NJIT

Spring 2016, Spring 2015, Fall 2014
MATH 340 - Applied Numerical Methods
Lab Instructor, NJIT

Spring 2014
MATH 139 - Trigonometry and Principles of Differential Calculus
TA / Recitation Instructor, NJIT

Fall 2013
MATH 133 - Calculus C & MATH 112 – Calculus II
TA / Recitation Instructor, NJIT

Spring 2013, Fall 2012
MATH 112 – Calculus II
TA / Recitation Instructor, NJIT

High School

Summer 2013
Teacher of Mathematics and Physics

Tech High School “Ricasoli“, Siena, Italy | Scientific Lyceum “Avocadro”, Siena, Italy

SERVICE

Poster session judge, Scientista Symposium, **Microsoft**, New York, NY *(April 13–15, 2018)*
Poster session judge, AMS Joint Mathematical Meeting, San Diego, CA *(January 12, 2018)*
Treasurer, SIAM Student Chapter and Mathematical Sciences PhD Club, NJIT *(2014–2016)*
Poster session judge, Scientista Symposium, **Microsoft**, New York, NY *(October 16–18, 2015)*

ORGANIZATIONS

American Association for the Advancement of Science / *Science Program for Excellence in Science* *(2016–2019)*
Association for Women in Mathematics *(2017–2018)*
Society for Industrial and Applied Mathematics *(2014–2018)*
Association for Computing Machinery *(2015–2019)*
American Physical Society *(2013–2015)*

TECHNICAL SKILLS

PROGRAMMING LANGUAGES: MATLAB, Fortran, C, C++, HTML, Java, Python
SOFTWARE AND TOOLS: LaTeX, Abaqus, Linux Bash, Git, Mathematica
GRAPHICS LIBRARIES: OpenGL, GLSL, GLM, OpenMesh
DATABASE: SQL