

# Curriculum Vitæ

Valeria Barra

## RESEARCH INTERESTS

---

Applied and Computational Mathematics, Numerical methods for Scientific Computing, Numerical Partial Differential Equations, Numerical Analysis, Computational Geometry, Computer Graphics, Computer Aided Geometric Design (CAGD), Computational Fluid Dynamics (CFD)

## APPOINTMENTS

---

- *PostDoctoral Research Associate* (June 04, 2018–September 30, 2020)  
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 high-order finite element or spectral element methods. This project is developed under the supervision of [Jed Brown](#) within the Center for Efficient Exascale Discretizations ([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 1, 2012–May 15, 2018)  
New Jersey Institute of Technology, Newark, NJ, USA (joint program with Rutgers University)  
PhD dissertation in 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 1, 2008–February 9, 2011)  
Università degli Studi di Siena, Siena, Italy  
Master's thesis in CAGD on Catmull-Clark subdivision surfaces. Independently designed and developed a code for both closed and open subdivision surfaces
- *Bachelor of Science in Mathematics* (October 1 2005–December 12, 2008)  
Università degli Studi di Siena, Siena, Italy
- *High School diploma* (September 1 2000–July 12, 2005)  
Scientific Lyceum, "Galileo Galilei", Siena, Italy

## PUBLICATIONS

---

- Valeria Barra, Shahriar Afkhami, Lou Kondic, *Thin viscoelastic dewetting films of Jeffreys type subjected to gravity and substrate interactions*, **The European Physical Journal E**, **42**, (2019), doi: <https://doi.org/10.1140/epje/i2019-11774-2>
- Valeria Barra, Shawn A. Chester, Shahriar Afkhami, *Numerical simulations of nearly incompressible viscoelastic membranes*, **Computers & Fluids**, **175**, (2018), doi: <https://doi.org/10.1016/j.compfluid.2018.07.023>
- Valeria Barra, *Numerical Simulations of Thin Viscoelastic Films*, PhD dissertation, **New Jersey Institute of Technology**, (2018), url: <https://digitalcommons.njit.edu/dissertations/1364>
- Valeria Barra, Shahriar Afkhami, Lou 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>

## TECHNICAL REPORTS

---

- *CEED ECP Milestone Report: Improve performance and capabilities of CEED-enabled ECP applications on Summit/Sierra* (March 31, 2020)  
Tzanio Kolev, Paul Fischer, Ahmad Abdelfattah, Shreyas Ananthan, *Valeria Barra*, Natalie Beams, Ryan Bleile, Jed Brown, Robert Carson, Jean-Sylvain Camier, Matthew Churchfield, Veselin Dobrev, Jack Dongarra, Yohann Dudouit, Ali Karakus, Stefan Kerkemeier, YuHsiang Lan, David Medina, Elia Merzari, Misun Min, Scott Parker, Thilina Ratnayaka, Cameron Smith, Michael Sprague, Thomas Stitt, Jeremy Thompson, Ananias Tomboulides, Stanimire Tomov, Vladimir Tomov, Arturo Vargas, Tim Warburton, Kenneth Weiss  
Doi: <http://doi.org/10.5281/zenodo.3860804>
- *CEED ECP Milestone Report: Performance tuning of CEED software and 1st and 2nd wave apps* (October 2, 2019)  
Stanimire Tomov, Ahmad Abdelfattah, *Valeria Barra*, Natalie Beams, Jed Brown, Jean-Sylvain Camier, Veselin Dobrev, Jack Dongarra, Yohann Dudouit, Paul Fischer, Ali Karakus, Stefan Kerkemier, Tzanio Kolev, YuHsiang Lan, Elia Merzari, Misun Min, Aleks Obabko, Scott Parker, Thilina Ratnayaka, Jeremy Thompson, Ananias Tomboulides, Vladimir Tomov, Tim Warburton  
doi: <https://doi.org/10.5281/zenodo.3477618>
- *CEED ECP Milestone Report: Improved Support for Parallel Adaptive Simulation in CEED* (July 12, 2019)  
Mark Shephard, *Valeria Barra*, Jed Brown, Jean-Sylvain Camier, Veselin Dobrev, Yohann Dudouit, Paul Fischer, Tzanio Kolev, David Medina, Misun Min, Thilina Ratnayaka, Cameron Smith, Morteza H. Siboni, Jeremy Thompson, Tim Warburton  
doi: <http://doi.org/10.5281/zenodo.3336420>
- *CEED ECP Milestone Report: Public release of CEED 2.0* (April 3, 2019)  
Jed Brown, Ahmad Abdelfattah, *Valeria Barra*, Veselin Dobrev, Yohann Dudouit, Paul Fischer, Tzanio Kolev, David Medina, Misun Min, Thilina Ratnayaka, Cameron Smith, Jeremy Thompson, Stanimire Tomov, Vladimir Tomov, Tim Warburton  
doi: <https://doi.org/10.5281/zenodo.2641316>

## INVITED TALKS AND SEMINARS

---

- *A light-weight library for performance-portable high-order operators: libCEED* (March 9, 2020)  
Computing and Computational Sciences Directorate, **Oak Ridge National Laboratory** (ORNL), Oak Ridge, TN, USA  
*Valeria Barra*
- *Toward efficient, high-order solvers for Computational Fluid Dynamics applications* (February 21, 2020)  
Global Systems Laboratory Seminar, **National Oceanic and Atmospheric Administration** (NOAA), Boulder, CO, USA  
*Valeria Barra*
- *Vectorized operator evaluations for solutions of PDEs on heterogeneous architectures with libCEED* (January 24, 2020)  
*Valeria Barra*  
Center for Applied Scientific Computing, **Lawrence Livermore National Laboratory** (LLNL), Livermore, CA, USA
- *libCEED: a versatile, extensible high-order finite elements library for performance portability* (October 2, 2019)  
*Valeria Barra*, Jed Brown, Jeremy Thompson, Yohann Dudouit  
Applied Math Seminar, Department of Mathematics, Colorado State University, Fort Collins, CO, USA
- *An efficient operator representation for High-Performance Computing* (July 8, 2019)  
*Valeria Barra*  
Department of Mathematics and its Applications "R. Caccioppoli", Università di Napoli Federico II, Naples, Italy

- [Efficient High-Order Operators and Library Reuse: libCEED \[video recording\]](#) (June 26, 2019)  
Valeria Barra, Jed Brown, Jeremy Thompson  
LANS Seminar, Mathematics and Computer Science Division, **Argonne National Laboratory** (ANL), Lemont, IL, USA
- *Numerical investigation of thin viscoelastic films and membranes* (October 22, 2018)  
Valeria Barra  
Postdoc Seminar, Department of Mathematics, Colorado State University, Fort Collins, CO, USA
- *Simulations of viscous fluids on curved surfaces* (January 30, 2017)  
Valeria Barra  
Fluid Mechanics and Waves Seminar, Department of Mathematical Sciences, NJIT, Newark, NJ, USA
- *Simulations of fluids on surfaces* (December 13, 2016)  
Valeria Barra, Fernando deGoes, Tony DeRose  
Research Seminar, **Pixar Animation Studios**, Emeryville, CA, USA

## CONTRIBUTED TALKS

---

1. [libCEED: an open-source library for efficient high-order operator evaluations](#) (December 10, 2019)  
American Geophysical Union 2019 Fall Meeting, San Francisco, CA, USA
2. [libCEED: lightweight high-order finite elements library](#) (November 17, 2019)  
[Women in HPC workshop](#) at [Supercomputing '19](#), Denver, CO, USA
3. [Efficient representation of high-order operators for the numerical solution of PDEs](#) (July 22, 2019)  
Valeria Barra, Jed Brown, Jeremy Thompson  
1<sup>st</sup> Women in Mathematics Meeting (WM<sup>2</sup>) in Portugal, FCT, Caparica, Portugal
4. [On performance portability and library reuse: A Navier-Stokes miniapp](#) (July 17, 2019)  
Valeria Barra, Jed Brown, Jeremy Thompson, Yohann Dudouit  
International Congress on Industrial and Applied Mathematics (ICIAM19), Valencia, Spain
5. *Interfacial dynamics of thin viscoelastic films and membranes* (March 22, 2019)  
Valeria Barra  
Interface Modeling and Formulations Workshop, Department of Aerospace Engineering Sciences, University of Colorado, Boulder, CO, USA
6. [Efficient solver composition with high-order methods \[video recording\]](#) (February 28, 2019)  
Valeria Barra, Jed Brown, Jeremy Thompson  
SIAM Conference on Computational Science and Engineering (CSE19), Spokane, WA, USA
7. [Efficient representation of high-order finite element operators](#) (February 15, 2019)  
Valeria Barra  
Applied Math and Computer Science Postdoc Seminar, University of Colorado, Boulder, CO, USA
8. *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
9. [Numerical simulations of thin viscoelastic films](#) (January 12, 2018)  
AMS Joint Mathematics Meeting, San Diego, CA
10. *Numerical study of thin viscoelastic films* (July 7, 2017)  
Department of Mathematical Sciences, NJIT, Newark, NJ
11. *Numerical study of thin viscoelastic films and drops* (July 18, 2016)  
Department of Mathematical Sciences, NJIT, Newark, NJ
12. [Wetting and dewetting of thin viscoelastic drops](#) (July 15, 2016)  
SIAM Annual Meeting, Boston, MA
13. *Interfacial dynamics of thin viscoelastic films and drops* (April 20, 2016)  
The Dana Knox Research Showcase, NJIT, Newark, NJ

14. [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
15. *Analysis and simulations of a thin film of viscoelastic fluid* (June 18, 2015)  
Department of Mathematical Sciences, NJIT, Newark, NJ
16. *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
17. *Analysis and simulations of a thin film of viscoelastic fluid* (July 10, 2014)  
Department of Mathematical Sciences, NJIT, Newark, NJ

## POSTERS

---

1. [libCEED - lightweight high-order finite elements library with performance portability and extensibility](#)  
[Supercomputing '19](#), Denver, CO, USA (November 17-22, 2019)
2. *Performance portability with matrix-free finite element operators*  
[PETSc User Meeting 2019](#), Georgia Tech, Atlanta, GA, USA (June 5-7, 2019)
3. *Gravity-driven instabilities of thin viscoelastic films on an inverted plane*  
*NSF Capstone Laboratory Project* (June 24-25, 2017)  
Frontiers in Applied and Computational Mathematics 2017, NJIT, Newark, NJ, USA
4. *Surface instabilities and droplets formation in thin viscoelastic films* (October 28, 2015)  
Graduate Students Research Day 2015, NJIT, Newark, NJ, USA
5. [Numerical study of thin layers of viscoelastic fluids](#) (October 16-18, 2015)  
Scientista Symposium, **Microsoft**, New York, NY, USA
6. *Numerical study of thin viscoelastic films on substrates* (June 5-6, 2015)  
Frontiers in Applied and Computational Mathematics 2015, NJIT, Newark, NJ, USA
7. [Numerical study of thin viscoelastic films on substrates](#) (March 14-18, 2015)  
SIAM Conference on Computational Science and Engineering, Salt Lake City, UT, USA
8. *Interfacial instability of thin viscoelastic liquid films* (October 30, 2014)  
Graduate Students Research Day 2014, NJIT, Newark, NJ, USA
9. *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, USA

## RESEARCH WORKSHOPS

---

- *Mathematical Problems in Industry*, NJIT, Newark, NJ, USA (June 17-21, 2019)  
**Under Armour**  
*Analyzing Viscoelastic Materials*  
Materials science and data science problem applied to the manufacturing of running shoes
- *Fluid Dynamics Software Infrastructure*, University of Colorado, Boulder, CO, USA ([website](#)) (April 12-13, 2019)
- *Mathematical Problems in Industry*, Claremont Graduate University, Claremont, CA, USA (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, USA (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, USA (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, USA (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, USA (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, USA (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

---

- *Rising Stars in Computational and Data Sciences* (April 7–8, 2020)  
Awarded nomination and selection for the [Rising Stars in Computational and Data Sciences Workshop](#), hosted at the Oden Institute of the University of Texas at Austin.
- *European Women in Mathematics Travel Award* (€400) (June 16, 2019)  
Awarded travel funds from the European Women in Mathematics (EWM) association to attend the [First Women in Mathematics Meeting \(WM<sup>2</sup>\)](#)
- *SIAM Early Career Travel Award* (\$2500) (March 05, 2019)  
Awarded travel funds from the U.S. National Science Foundation (NSF) to attend the [9th International Congress on Industrial and Applied Mathematics \(ICIAM 2019\)](#)
- *SIAM Early Career Travel Award* (\$650) (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* (\$1000) (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, USA
- *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, USA
- *Best Research Poster Award* (October 30, 2014)  
Best research poster for the Department of Mathematical Sciences, Graduate Students Research Day 2014, NJIT, Newark, NJ, USA
- *University of Siena Mobility Fellowship (full-ride fellowship)* (Fall 2011–Spring 2012)  
Selected from over 80 candidates to receive full funding (i.e., tuitions and fees, room, and board) to spend two semesters at the New Jersey Institute of Technology, Newark, NJ, USA 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, Italy, graduating with *summa cum laude* 110/110 GPA honors degree
- *University of Siena Scholarship (full-ride scholarship)* (Fall 2005–Spring 2011)

Full-ride scholarship: tuitions and fees, room, board and living expenses (€3600 per year), for the entire duration of Bachelor of Science and Master of Science degrees in Mathematical Sciences from the University of Siena, Italy

## 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

---

### POSTDOC TUTORIALS

Fall 2019:

Role: *Instructor*,

LaTeX, MATLAB

Postdoctoral Association of Colorado, CU Boulder

### PHD PROGRAM COURSES

Spring 2018:

Role: *Teaching Assistant*,

MATH 614 – Numerical Methods I, NJIT

Fall 2015:

Role: *Lab Instructor*,

MATH 599 – Teaching in Mathematics, NJIT

### UNDERGRADUATE COURSES

Fall 2017:

Role: *Instructor*,

MATH 337 – 017 Linear Algebra, NJIT

Spring 2017:

Role: *Lab Instructor*,

MATH 451 – NSF Capstone Laboratory, NJIT

Spring 2016, Spring 2015, Fall 2014:

Role: *Lab Instructor*,

MATH 340 - Applied Numerical Methods, NJIT

Spring 2014:

Role: *Teaching Assistant / Recitation Instructor*,

MATH 139 - Trigonometry and Principles of  
Differential Calculus, NJIT

Fall 2013:

Role: *Teaching Assistant / Recitation Instructor*,

MATH 133 - Calculus C & MATH 112 – Calculus II,  
NJIT

Spring 2013, Fall 2012:

Role: *Teaching Assistant / Recitation Instructor*,

MATH 112 – Calculus II, NJIT

### HIGH SCHOOL

Summer 2013:

Role: *Teacher of Mathematics and Physics*

Tech High School "Ricasoli", Siena, Italy

Scientific Lyceum "Avocado", Siena, Italy

## MENTORING EXPERIENCE

---

- **Lead the Future** (Fall 2019–present)  
Giulia Mescolini (B. Sc. Polytechnic University of Milan, Italy), Maria Teresa Rotolo (B. Sc. University of Palermo, Italy), Francesco Viganó (M. Sc. University of Milan, Italy and Université de Paris-Sud, France), Maria Bevilacqua (B. Sc. University of Salerno, Italy)
- **Summer Program for Undergraduate Research**, University of Colorado, Boulder, CO, USA (Summer 2019)  
Joseph Geisz (M. Sc./B. Sc. in Applied Math, University of Colorado Boulder)

## PROFESSIONAL ACTIVITIES

---

- *Chair of the [AMS Special Session on Recent Developments in Numerical Methods for PDEs](#) at the AMS Joint Mathematics Meeting 2010, Denver, CO, USA* (January 15–18, 2020)
- *[Postdoctoral Association of Colorado Boulder](#) workshop/tutorial series organizer* (Fall 2019–present)
- *Chair of the [Applied Math and Computer Science Postdoc Seminar](#), University of Colorado, Boulder, CO, USA* (Fall 2018–Spring 2019)

## PROFESSIONAL DEVELOPMENT WORKSHOPS

---

- *[Argonne Training Program on Extreme-scale computing \(ATPESC\)](#), St. Charles, IL, USA (July 26–August 7, 2020)*  
An intensive training organized by the U.S. Department of Energy's (DOE) Argonne National Laboratory and funded by DOE's Exascale Computing Project (ECP)
- *[Supercomputing '19 Early Career Program](#), Denver Convention Center, Denver, CO, USA* (November 18, 2019)
- *[Women in HPC Workshop at SC'19](#), Denver Convention Center, Denver, CO, USA* (November 17, 2019)
- *[CIRTL Evidence-Based Introduction to Teaching](#), University of Colorado, Boulder, CO, USA* (August 2, 2019)
- *[Research & Writing Professional Development Certification](#), University of Colorado, Boulder, CO, USA* (April 2, 2019)

## SERVICE

---

- *[Skype A Scientist](#), volunteer scientist to talk to students from K-12 grades* (Spring 2020)
- *Poster judge, for MAA Undergraduate Student Poster Session, AMS JMM 2020, Denver, CO, USA* (Jan. 17, 2020)
- *Reviewer, for the Journal of Non-Newtonian Fluid Mechanics, Elsevier* (Dec. 2019–present)
- *Poster and eLightning talk sessions Outstanding Student Presentation Award (OSPA) judge, AGU Fall Meeting 19, San Francisco, CA, USA* (Dec. 09–13, 2019)
- *Mentor, for four mentees, [Lead the Future](#)* (Fall 2019–present)
- *Advisory board, Postdoctoral Association of Colorado Boulder, Boulder, CO* (Fall 2019–present)
- *Poster session judge, for the Association for Women in Mathematics, SIAM CSE19, Spokane, WA, USA* (Feb. 25–Mar. 1, 2019)
- *Poster session judge, Scientista Symposium, **Microsoft**, New York, NY, USA* (Apr. 13–15, 2018)
- *Poster session judge, AMS Joint Mathematical Meeting, San Diego, CA, USA* (Jan. 12, 2018)
- *Treasurer, SIAM Student Chapter and Mathematical Sciences PhD Club, NJIT, USA* (2014–2016)
- *Poster session judge, Scientista Symposium, **Microsoft**, New York, NY, USA* (Oct. 16–18, 2015)

## ORGANIZATIONS

---

American Association for the Advancement of Science / *Science Program for Excellence in Science* (2016–2021)  
Women in High-Performance Computing (2019–2020)  
Association for Women in Science (2019–2020)  
European Women in Mathematics (2019–2020)  
Society for Industrial and Applied Mathematics (2014–2019)  
Association for Computing Machinery (2015–2019)  
Association for Women in Mathematics (2017–2019)  
American Physical Society (2013–2015)

## TECHNICAL SKILLS

---

PROGRAMMING LANGUAGES: MATLAB, Fortran, C, C++, Python, HTML, Java  
SOFTWARE AND TOOLS: Linux Bash, Git, LaTeX, Abaqus, Mathematica  
SCIENTIFIC COMPUTING LIBRARIES: libCEED, PETSc  
DOCUMENTATION: Sphinx  
GRAPHICS LIBRARIES: OpenGL, GLSL, GLM, OpenMesh

## PRESS COVERAGE

---

New Jersey Institute of Technology NEWS, "[Finding Valeria: A Ph.D. Story](#)"

(January 5, 2017)