Valerie Rose Coffman, PhD

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EDUCATION

Cornell University, Ithaca, NY

- PhD Physics, January 2007, Dissertation title: "Macroscopic effects of atomic scale defects in crystals: Grain boundary fracture and brittle-ductile transitions", Advisor: James P. Sethna
- M.S. Physics, January 2006

Johns Hopkins University, Baltimore, MD

- B.S. Physics with concentration in Computer Science, May 2000

EXPERIENCE

National Institute of Standards and Technology, Gaithersburg, MD

NRC Postdoctoral Associate with Dr. Stephen Langer — 2008-present
Guest Researcher with Dr. Stephen Langer — 2006-2008

Department of Physics, Cornell University, Ithaca, NY

Teaching Assistant — 2005-2006
Graduate Research Assistant with Prof. James P. Sethna — 2002-2004
Research Assistant with Prof. Jane Wang — 2000-2002

Space Telescope Science Institute, Baltimore, MD

Intern, Spectrographs Group — 1998-1999

Department of Physics and Astronomy, Johns Hopkins University, Baltimore, MD

Lab Assistant, Sounding Rocket Lab — Summer 1998
Tutor, Drop-in Physics Tutoring Program — 1997-2000

Department of Physics, Williams College, Williamstown, MA

Research Assistant with Prof. William K. Wootters — Summer 1997

RESEARCH INTERESTS

I am currently working on 3D image-based meshing methods for material microstructures and the related computational geometry challenges. I am interested in applying these meshing techniques to trabecular bone, increasing the computational efficiency of finite element models and the range of possible length scales and physics. I am also interested in combining molecular dynamics with image-based finite element models to create multiscale simulations of real microstructures that can be compared directly to fracture experiments.

HONORS, FELLOWSHIPS, GRANTS

- National Research Council Postdoctoral Associateship, National Institute of Standards and Technology, 2007
- National Institute of Standards and Technology Research Grant, Cornell University, 2006
- National Science Foundation Integrative Graduate Education and Research Traineeship, Cornell University, 2000
- General and Departmental Honors, Johns Hopkins University, 2000
- National Science Foundation Research Experience for Undergraduates, Williams College, 1997

TEACHING

- Physics of the Heavens and Earth: a review course for non-majors, Cornell Physics 203, with Prof. Hasan Padamsee, Spring 2006
- Why the Sky is Blue: a review course for non-majors, Cornell Physics 201, with Dr. Ahren Sadoff, Fall 2005
- Introductory Mechanics for Engineers, Cornell Physics 112, with Dr. Phil Krasicky, Spring 2005

OUTREACH

- Authored an article for the Ithaca Times "Ask A Scientist" column entitled "Photoelectric Effect is the Reason Digital Cameras Work".
- Helped lead the "Crackling Noise!" workshop as part of the "Expanding Your Horizons" conference for seventh and eighth grade girls interested in science.

TECHNICAL

Proficient in major languages, libraries, web technologies, and operating systems including C++, Python, GTK+, VTK, Matlab, Mathematica, SQL, HTML, XML, XQuery, Linux, Mac OS X. Experienced in molecular dynamics, finite element, computational fluid dynamics, and simulated annealing modeling techniques.

SCIENTIFIC SOFTWARE

- **3D Object Oriented Finite Elements (OOF3D):** A software package for calculating macroscopic material properties from three-dimensional images of microstructures using finite element models. OOF3D is written in Python and C++, uses the VTK library for 3D visualization, and runs on Linux and Mac OS X. Documentation and source code for the current version of OOF are available at www.ctcms.nist.gov/oof/.
- **Overlapping Finite Elements and Molecular Dynamics (OFEMD):** An application for running molecular dynamics simulations within a finite element model. OFEMD is written in Python and runs in parallel on both Linux and Windows. Related papers and source code can be downloaded from www.lassp.cornell.edu/sethna/DM/mdwebservices/.

SCIENTIFIC SOFTWARE (continued)

- **GrainBreaker:** A molecular dynamics application that calculates the cohesive law for 2D and 3D grain boundaries for a variety of materials. GrainBreaker is written in Python and runs in parallel on both Linux and Windows.
- **DigitalMaterial:** A flexible molecular dynamics library, written in Python and C++, that runs in parallel on both Linux and Windows. The source code and documentation are available at www.lassp.cornell.edu/sethna/DM/Software.html.

CONFERENCES, WORKSHOPS, PRESENTATIONS

- 21st NIST Computer Modeling Workshop, Gaithersburg, MD, August 11-13, 2010. Talk: "Object-Oriented Finite Elements (OOF) for Modeling Materials Behavior".
- Society for Experimental Mechanics Annual Conference, Indianapolis, IN, June 7-10, 2010. Talk: "OOF3D: An Image-Based Finite Element Solver for Materials Science".
- George Mason University, Applied and Computational Math Seminar, Fairfax, VA, November 13, 2009. Talk: "OOF: An Image-Based Finite Element Solver for Materials Science".
- MASCOT 2009, Rome, Italy, October 28-30, 2009. Talk: "OOF: An Image-Based Finite Element Solver for Materials Science".
- 10th National Congress on Computational Mechanics, Columbus, OH, July 16-19, 2009. Talk: "Validating virtual polycrystals with OOF".
- Society for Experimental Mechanics Annual Conference, Albuquerque, NM, June 1-4, 2009. Talk: "Challenges in continuum modeling of intergranular fracture".
- SIMAI 2008. University of Rome La Sapienza, Rome, Italy, September 15-19, 2008. Talk: "Challenges in understanding intergranular fracture in polycrystals".
- Second New York Complex Matter Workshop, Cornell University, Ithaca, NY, July 21, 2006. Talk: "Grain boundary cohesive laws as a function of geometry".
- American Physical Society March Meeting, Baltimore, MD, March 13-17, 2006. Talk: "Grain boundary cohesive laws as a function of geometry".
- 92nd Statistical Mechanics Conference, Rutgers University, Rutgers, NJ, December 19-21, 2004. Talk: "A generalization of the Andreev-Lifshitz theory of supersolid helium".
- American Physical Society March Meeting, Montreal, Quebec, Canada, March 22-26, 2004. Talk: "Atomistic modeling of grain boundary fracture".
- DIMACS Quantum Computing Tutorial and Workshop, Princeton University, Princeton, NJ, August 11-15, 1997. Poster: "Distributed Entanglement".

PAPERS IN PROGRESS

1. "OOF3D: An Image-Based Finite Element Solver for Materials Science ", **Valerie R. Coffman**, Andrew C.E. Reid, Stephen A. Langer, Gunay Dogan, *Submitted*.

PAPERS IN PROGRESS (continued)

2. "Element homogeneity: calculating the intersection of finite elements with voxelized regions", **Valerie R. Coffman**, Andrew C.E. Reid, Stephen A. Langer, *In Preparation.*
3. "Digital Material: a flexible atomistic simulation code", Nicholas Bailey, Thierry Cretegny, James P. Sethna, **Valerie R. Coffman**, Andrew J. Dolgert, Christopher R. Myers, Jakob Schiotz, Jens Jorgen Mortensen, arXiv:cond-mat/0601236.

REFEREED PUBLICATIONS

1. "Challenges in Continuum Modelling of Intergranular Fracture", **Valerie R. Coffman**, James P. Sethna, Jeff Bozek, Anthony Ingraffea, Nicholas P. Bailey and Erin I. Barker, *To appear in Strain* (2010).
2. "Modelling Microstructures with OOF2", Andrew C.E. Reid, Rhonald C. Lua, R. Edwin García, **Valerie R. Coffman** and Stephen A. Langer, *International Journal of Materials and Product Technology* **35**, p 361-373 (2009).
3. "Image-based Finite Element Mesh Construction for Material Microstructures", Andrew C.E. Reid, Stephen A. Langer, Rhonald C. Lua, **Valerie R. Coffman**, Seung-Ill Haan and R. Edwin García, *Computational Materials Science* **43**, p 989-999 (2008).
4. "A comparison of finite element and atomistic modelling of fracture", **Valerie R. Coffman**, James P. Sethna, Gerd Heber, Mu Liu, Anthony Ingraffea, Nicholas P. Bailey and Erin I. Barker, *Modelling Simul. Mater. Sci. Eng.* **16**, 065008 (2008).
5. "Grain boundary energies and cohesive strength as a function of geometry", **Valerie R. Coffman** and James P. Sethna, *Phys. Rev. B* **77**, 144111 (2008).
6. "Scaling in Plasticity-Induced Cell-Boundary Microstructure: Fragmentation and Rotational Diffusion", James P. Sethna, **Valerie R. Coffman**, and Eugene Demler, *Phys. Rev. B* **67**, 184107 (2003).
7. "Distributed Entanglement", **Valerie R. Coffman**, Joydip Kundu, and William K. Wootters, *Phys. Rev. A* **61**, 052306 (2000).