

CHRISTOPHER J. LARSEN

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Education:

Ph.D., Mathematics, Carnegie Mellon University, 1996

M.S., Applied Mathematics, Carnegie Mellon University, 1994

J.D., University of Maryland School of Law, 1992

B.S., Physics, Carnegie Mellon University, 1989

Appointments:

2004-present: Associate Professor, Department of Mathematical Sciences, Worcester Polytechnic Institute

January-June 2006: Visiting Associate in Mechanical Engineering, California Institute of Technology

March/May 2003: Invited Professor, University of Paris-Dauphine

May 2002: Invited Professor, University of Paris-Nord

Sept/Oct 2001: Invited Professor, University of Paris-Dauphine

May 2001: Invited Professor, University of Paris-Nord

1999-2004: Assistant Professor, Department of Mathematical Sciences, Worcester Polytechnic Institute

1996-1999: Visiting Assistant Professor, Department of Mathematical Sciences, Worcester Polytechnic Institute

Research Funding:

NSF: "Variational methods for material defect evolution." 2010 - 2013. Awarded Amount: \$167,534

NSF: "Damage and fracture evolution." 2008 - 2011. Awarded Amount: \$162,228

NSF: "Variational methods for material damage: fracture, fatigue, and debonding." 2005 - 2008. Awarded Amount: \$240,450

Honors:

Leverhulme Visiting Professor, University of Bristol

Graduate Students:

Ph.D.:

Casey L. Richardson, Ph.D. 2008. CAM Assistant Professor, UCLA 2008-2011

Eric Mbakop, Ph.D. expected 2015

Masters:

David Evans, M.S. 2011

Publications:

Books:

“*BV* Spaces and Applications to Fracture Mechanics,” Springer-Verlag, expected spring 2012

“A Guide to *SBV* and Applications,” in preparation under contract with Springer-Verlag.

Articles:

1. G. DAL MASO and C. J. LARSEN, Existence for wave equations on domains with arbitrary growing cracks, *Rend. Lincei Mat. Appl.* **22** (2011), pp. 387-408.
2. C. J. LARSEN, Local minimality and crack prediction in quasi-static Griffith fracture evolution, *Discrete Contin. Dyn. Syst. Series S*, to appear.
3. B. BOURDIN, C. J. LARSEN, and C. L. RICHARDSON, A time-discrete model for dynamic fracture based on crack regularization, *Int. J. Fracture* **168** (2011), pp. 133-143.
4. A. BRAIDES and C. J. LARSEN, Γ -convergence for stable states and local minimizers, *Ann. Scuola Norm. Sup. Pisa Cl. Sci. (5)* **X** (2011), pp. 193-206.
5. H. JIANG, C. J. LARSEN, and L. SILVESTRE, Full regularity of a free boundary problem with two phases, *Calc. Var. Partial Differential Equations* **42** (2011), pp. 301-321.
6. C. J. LARSEN, Epsilon-stable quasi-static brittle fracture evolution, *Comm. Pure Appl. Math.* **63** (2010), pp. 630-654.
7. C. J. LARSEN, C. ORTNER, and E. SÜLI, Existence of solutions to a regularized model of dynamic fracture, *Math. Models Methods Appl. Sci.* **20** (2010), pp. 1021-1048.
8. C. J. LARSEN, *Models for dynamic fracture based on Griffith's criterion*, in IUTAM Symposium on Variational Concepts with Applications to the Mechanics of Materials (Klaus Hackl, ed.), Springer, 2010, pp. 131-140.

9. A. GARRONI and C. J. LARSEN, Threshold-based quasi-static brittle damage evolution, *Arch. Ration. Mech. Anal.* **194** (2009), pp. 585-609.
10. C. J. LARSEN, M. ORTIZ, and C. L. RICHARDSON, Fracture paths from front kinetics: relaxation and rate-independence, *Arch. Ration. Mech. Anal.* **193** (2009), pp. 539-583.
11. C. J. LARSEN, C. L. RICHARDSON, and M. SARKIS, A level set method for the Mumford-Shah functional and fracture, *Technical Report Serie A 581* (2008), Instituto de Matematica Pura e Aplicada, Brazil.
12. G. A. FRANCFORT and C. J. LARSEN, Existence and convergence for quasi-static evolution in brittle fracture, *Comm. Pure Appl. Math.* **56** (2003), pp. 1465-1500.
13. A. CHAMBOLLE and C. J. LARSEN, C^∞ regularity of the free boundary for a two-dimensional optimal compliance problem, *Calc. Var. Partial Differential Equations* **18** (2003), pp. 77-94.
14. C. J. LARSEN, Regularity of components in optimal design problems with perimeter penalization, *Calc. Var. Partial Differential Equations* **16** (2003), pp. 17-29.
15. C. J. LARSEN, Regularity in two-dimensional variational problems with perimeter penalties, *C. R. Acad. Sci. Paris Sér. I Math.* **333** (2001), pp. 261-266.
16. C. J. LARSEN and R. LUI, Uniqueness of steady-states and asymptotic behavior of solutions of a liquid junction model with insulation, *Nonlinear Anal. Real World Appl.* **3** (2002), pp. 227-241.
17. C. J. LARSEN, On the representation of effective energy densities, *ESAIM Control Optim. Calc. Var.* **5** (2000), pp. 529-538.
18. C. J. LARSEN, Distance between components in optimal design problems with perimeter penalization, *Ann. Scuola Norm. Sup. Pisa Cl. Sci.* **28** (1999), pp. 641-649.
19. C. J. LARSEN, A new proof of regularity for two-shaded image segmentations, *Manuscripta Math.* **96** (1998), pp. 247-262.
20. C. J. LARSEN, Quasiconvexification in $W^{1,1}$ and optimal jump microstructure in BV relaxation, *SIAM J. Math. Anal.* **29** (1998), pp. 823-848.

Invited Conference Presentations as a Primary Speaker:

1. Computational Methods for Multiscale Modeling of Materials Defects, IPAM, December 2012
2. White Nights Workshop: "Exotic Structures and Homogenization," Saint Petersburg, Russia, July 2012
3. International Conference on Variational Problems with Multiple Scales, Otranto, Italy, June 2012
4. Oberwolfach workshop on Variational Methods for Evolution, December 2011
5. (Keynote) International Workshop on Phase Separation, Damage and Fracture, WIAS Berlin, September 2011

6. Banff workshop on Rate-independent systems: Modeling, Analysis, and Computations, August 2010 (video)
7. Oberwolfach workshop on Microstructures in Solids: From Quantum Models to Continua, March 2010
8. International Union of Theoretical and Applied Mechanics Symposium “Variational Concepts with Applications to the Mechanics of Materials,” Bochum, Germany, September 2008
9. Oxford Workshop on Fracture, Oxford, England, March 2008
10. (Plenary) ICM2006 Satellite Conference “New Trends and Challenges in the Calculus of Variations and its Applications,” Toledo, Spain, August 2006
11. Workshop on Rate-Independent Processes, Paris, France, August 2004
12. Workshop on Calculus of Variations, Savoie, France, June 2003

Conferences Organized:

1. 48th Annual Technical Meeting of Society of Engineering Sciences, Symposium on Defect Evolution in Materials, Evanston, IL, October 2011
2. Oberwolfach mini-workshop on Mathematical Models, Analysis, and Numerical Methods for Dynamic Fracture (organized with G. Dal Maso and C. Ortner), April 2011
3. AMS Sectional Meeting, Special Session on Quasi-static and Dynamic Evolution in Fracture Mechanics, Worcester, MA, April 2009
4. SIAM Conference on Mathematical Aspects of Materials Science, four Special Sessions on Damage and Fracture Evolution (invited, organized with G. Dal Maso, G. Francfort, and A. Garroni), Philadelphia, PA, May 2008
5. Workshop on Free Discontinuity Problems: From Image Processing to Materials Science (organized with B. Bourdin), Baton Rouge, LA, January 2007
6. Joint Mathematics Meetings, AMS Special Session on Free Discontinuity Problems: From Image Processing to Materials Science (organized with B. Bourdin), New Orleans, LA, January 2007
7. First SIAM Meeting on Analysis of Partial Differential Equations, Special Session on Free Boundary Problems and Optimal Transportation (organized with R. Jerrard), Houston, TX, December 2004

Invited Conferences:

1. International Congress on Industrial and Applied Mathematics, minisymposium on Modern Methods and Applications of the Calculus of Variations: Fracture Mechanics and Plasticity, Vancouver, July 2011
2. International Congress on Industrial and Applied Mathematics, minisymposium on Multiscale Phenomena in Calculus of Variations and Inverse Problems, Vancouver, July 2011

3. SIAM Conference on Mathematical Aspects of Materials Science, Special Session on New Frontiers in Calculus of Variations and Applications to Materials Science, Philadelphia, PA, May 2010
4. SIAM Conference on Analysis of Partial Differential Equations, Special Session on Variational Methods in Materials Science, Miami, Florida, December 2009
5. SIAM Conference on Mathematical Aspects of Materials Science, Special Session on Variational Models for Advanced Materials, Philadelphia, PA, May 2008
6. SIAM Conference on Analysis of Partial Differential Equations, Special Session on Free Boundary Problems And Beyond, Mesa, Arizona, December 2007
7. SIAM Conference on Analysis of Partial Differential Equations, Special Session on Gradient Fields, Stresses, and Free Surfaces in Heterogeneous Materials, Mesa, Arizona, December 2007
8. Society of Engineering Science Annual Meeting, Special Session on Transport Properties of Micro-structured Media and Composite Materials, College Station, Texas, October 2007
9. International Congress on Industrial and Applied Mathematics, minisymposium on Mathematical Modeling and Numerical Analysis of Fracture Phenomena, Zurich, July 2007
10. International Congress on Industrial and Applied Mathematics, minisymposium on Mathematical Aspects of Materials Science: Plasticity and Fracture, Zurich, July 2007
11. Oberwolfach workshop on Analysis and Numerics for Rate-Independent Processes, February 2007 (declined due to conflict)
12. Joint Mathematics Meetings, AMS Special Session on Calculus of Variations and Nonlinear PDE: Theory and Applications, New Orleans, LA, January 2007
13. AMS Sectional Meeting, Special Session on Nonconvex Variational Problems: Recent Advances and Applications, University of Utah, October 2006
14. SIAM Meeting on Analysis of Partial Differential Equations, Special Session on Contemporary Developments in Calculus of Variations and PDE, Boston, MA, July 2006
15. IX Conference on Partial Differential Equations, IMPA, Brazil, July 2005
16. First SIAM Meeting on Analysis of Partial Differential Equations, Special Session on Calculus of Variations, PDE and Mass Transport, Houston, TX, December 2004
17. First Joint Meeting of the AMS-UMI, Special Session on Contemporary Developments in Partial Differential Equations and in the Calculus of Variations, Pisa, Italy, June 2002
18. Nonlinear Analysis 2000→, Courant Institute, May 2000
19. SIAM conference on Mathematical Aspects of Materials Science, Special Session on Optimal Design of Structures and Microstructures, Philadelphia, May 2000
20. Workshop on Structured Deformations, Carnegie Mellon University, January 1999
21. Canadian Applied Mathematics Society meeting, Simon Fraser University, May 1998

22. AMS Sectional Meeting, Special Session on Recent Developments in PDE's, Calculus of Variations, and Applications to Problems in Materials Science, Georgia Tech, October 1997

Invited Seminars:

1. Analysis Seminar, University of Rome "La Sapienza", October 2011
2. Analysis and Applied Math Seminar, University of Toronto, February 2011
3. Applied and Computational Mathematics Seminar, Georgia Tech, October 2010
4. Centre for Nonlinear Mechanics Seminar, University of Bath, May 2009
5. Lecture Series: *A Guide to SBV and Applications*, University of Oxford, May 2009
6. PDE Seminar, Brown University, April 2009
7. Analysis Seminar, University of Bristol, November 2008
8. OxPDE Seminar, University of Oxford, November 2008
9. Analysis Seminar, SISSA, Trieste Italy, October 2008
10. Applied Math Seminar, University of Glasgow, March 2008
11. CMAP Seminar, Ecole Polytechnique, Paris, February 2008
12. Applied Math Seminar, Temple University, February 2007
13. Mathematical Physics Seminar, Caltech, May 2006
14. Analysis Seminar, SISSA, Trieste Italy, May 2006
15. Applied Math Seminar, UC Irvine, March 2006
16. Mathematics Colloquium, Louisiana State University, March 2006
17. Lecture Series: *A Guide to SBV and Applications*, Caltech, January-March 2006
18. Differential Equations Seminar, University of Rome "La Sapienza", November 2005
19. Numerical Analysis Seminar, Ecole Polytechnique, Paris, November 2005
20. Applied Analysis Seminar, Weierstrass Institute, Berlin, November 2005
21. Analysis Seminar, University of Warwick, October 2005
22. Center for Nonlinear Analysis Seminar, Carnegie Mellon University, March 2005
23. Partial Differential Equations Seminar, IMPA, Brazil, May 2004
24. Calculus of Variations Seminar, University of Paris-Dauphine, March 2003
25. Computer Science Research Institute Seminar, Sandia National Laboratories, October 2002
26. Harmonic Analysis Seminar, University of Paris-Sud, June 2002

27. Partial Differential Equations Seminar, University of Savoie, May 2002
28. Homogenization and Multiple Scales Seminar, University of Paris VI, May 2002
29. Calculus of Variations Seminar, University of Paris-Dauphine, March 2002
30. Applied and Computational Mathematics Seminar, Caltech, February 2002
31. Center for Nonlinear Analysis Seminar, Carnegie Mellon University, January 2002
32. Applied Mechanics Seminar, Caltech, October 2001
33. Computer Science Research Institute Seminar, Sandia National Laboratories, September 2001
34. Seminar of the Laboratoire Jacques-Louis Lions, University of Paris VI, May 2001
35. Applied Analysis and Computation Seminar, University of Massachusetts-Amherst, March 2001
36. Center for Nonlinear Analysis Seminar, Carnegie Mellon University, April 2000
37. Applied and Computational Mathematics Seminar, Penn State University, April 2000
38. Image Science Seminar, Computer Science Department, WPI, November 1999
39. Harmonic Analysis Seminar, University of Paris-Sud, March 1999
40. Differential Equations Seminar, North Carolina State University, December 1998
41. Stochastic and Nonlinear Analysis Seminar, University of Illinois at Urbana-Champaign, September 1998
42. Differential Equations Seminar, University of Connecticut, September 1997
43. Mathematics Colloquium, WPI, September 1996
44. Mathematics Colloquium, University of Missouri-Rolla, February 1996

Invitations:

1. IPAM (UCLA) program on “Materials Defects: Mathematics, Computation, and Engineering,” invited “long term core participant,” fall 2012
2. University of Rome, November 2011, one week
3. Caltech, January 2011, one week
4. University of Bonn, Germany, March 2010, three days
5. University of Oxford, May 2009, one week
6. Louisiana State University, LA, January 2009, four days
7. University of Oxford, November 2008, one month
8. University of Rome, October 2008, one week

9. SISSA, Trieste, Italy, October 2008, one week
10. University of Oxford, March 2008, one week
11. University of Rome, February 2008, two weeks
12. Ecole Polytechnique, Paris, February 2008, two weeks
13. Louisiana State University, LA, January 2008, one week
14. SISSA, Trieste, Italy, July 2007, one week
15. University of Rome, March 2007, one week
16. Caltech Department of Aerospace Engineering, January 2007, one week
17. SISSA, Trieste, Italy, May 2006, one week
18. University of Rome, February 2006, two weeks
19. University of Rome, November 2005, one week
20. Ecole Polytechnique, Paris, December 2005, three days
21. Weierstrass Institute, Berlin, November 2005, one week
22. University of Paris-Nord, October 2005, one week
23. University of Warwick, England, August 2005, three months
24. IMPA, Brazil, July 2005, one month
25. IMA, University of Minnesota, June 2005, one week
26. Carnegie Mellon University, PA, March 2005, one week
27. IMA, University of Minnesota, October-November 2004, two weeks
28. IMPA, Brazil, May 2004, one week
29. University of Bonn, Germany, June 2003, one week
30. Sandia National Laboratories, NM, October 2002, one week
31. University of Savoie, France, May 2002, three days
32. Carnegie Mellon University, PA, January 2002, two weeks
33. Caltech Department of Applied Mechanics, CA, October 2001, two weeks
34. University of Paris-Dauphine, France, September-October 2001, two weeks
35. Sandia National Laboratories, NM, September 2001, one week
36. University of Bonn, Germany, June 2001, one week
37. Caltech Department of Applied Mechanics, CA, April 2001, two days

38. Carnegie Mellon University, PA, April 2000, one week
39. Penn State University, PA, April 2000, one week
40. Carnegie Mellon University, PA, May 1999, one week
41. University of Paris-Sud, France, March 1999, one week
42. Carnegie Mellon University, PA, January 1999, one week
43. North Carolina State University, NC, December 1998, four days
44. Simon Fraser University, Canada, May 1998, one week

Refereeing:

Communications on Pure and Applied Mathematics
 Archive for Rational Mechanics and Analysis
 Calculus of Variations and Partial Differential Equations
 SIAM Journal on Mathematical Analysis
 SIAM Journal on Numerical Analysis
 Annali della Scuola Normale Superiore di Pisa Classe di Scienze
 International Journal of Fracture
 Journal of Elasticity
 Proceedings of the Royal Society A
 Journal of Nonlinear Science
 The Royal Society of Edinburgh Proceedings A (Mathematics)
 Mathematical Modelling and Numerical Analysis
 ESAIM: Control, Optimisation and Calculus of Variations
 Interfaces and Free Boundaries
 Applied Mathematics and Optimization
 Journal of Mathematical Analysis and Applications
 Optimization

Ph.D. Thesis Referee, Functional Analysis and Applications Sector, SISSA

NSF panelist, Division of Mathematical Sciences, Materials and Continuum Mechanics Panel

Courses Developed:

- Introduction to Analysis I - IV, a Freshman sequence as an alternative to the Calculus sequence, for motivated Freshmen (with B. Vernescu)
- Graduate Topics course on Partial Differential Equations
- Undergraduate Topics course on Mathematics of Quantum Mechanics
- Undergraduate Topics course on Topology

Undergraduate Projects:

- Stable Convergence of the Ambrosio-Tortorelli Functionals
- Continuity of Crack Sets in Dynamic Fracture
- SBV Compactness
- Weak Topologies and Metrizability (runner-up, Provost's award)
- Interdisciplinary Project: Coalitions in the U.S. Supreme Court
- Interaction of Gravity and Electromagnetic Waves
- Heat Flow in Porous Media, co-advised with B. Vernescu (runner-up, Provost's award)
- Interdisciplinary Project: Civil Standards and Justice
- Notions of Size for Infinite Sets and Applications (winner, Provost's award)
- Two Projects for WPI's Industrial Math REU program