

# Jianfeng Lu

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March 4, 2012

## POSITIONS

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*Current*    **Courant Instructor**  
2009 – Courant Institute of Mathematical Sciences  
New York University

## EDUCATION

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2009    Ph.D. in APPLIED MATHEMATICS, Princeton University  
2005    B.S. in MATHEMATICS, Peking University, Beijing, China

## RESEARCH INTERESTS

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Mathematical analysis and numerical methods for problems arising from physics, material science, computational chemistry, and exploration seismology, in particular, electronic structure theory, molecular simulation, multiscale methods, pattern formation, rare events, and wave propagation.

## AWARDS

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2008    **Porter Ogden Jacobus Fellowship**, Princeton University  
*The highest honorific fellowship awarded by the Graduate School of Princeton University.*

## PUBLICATION

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- Frozen Gaussian approximation for general linear strictly hyperbolic system: formulation and Eulerian methods (with Xu Yang), *Multiscale Model. Simul.*, to appear.
- Adaptive local basis set for Kohn-Sham density functional theory in a discontinuous Galerkin framework I: Total energy calculation (with Weinan E, Lin Lin, and Lexing Ying), *J. Comput. Phys.*, to appear.
- The Kohn-Sham equation for deformed crystals (with Weinan E), *Mem. Amer. Math. Soc.*, to appear.
- Convergence of frozen Gaussian approximation for high frequency wave propagation (with Xu Yang), *Comm. Pure Appl. Math.*, to appear.

- Asymptotic analysis of the quantum dynamics: Bloch-Wigner transform and Bloch dynamics  
(with Weinan E and Xu Yang), *Acta Math. Appl. Sin. Engl. Ser.*, to appear
- Multiscale modeling (invited mini-review article)  
(with Weinan E), *Scholarpedia*, 6(10):11527 (2011).
- Markov state models based on milestoning  
(with Frank Noé, Marco Sarich, Christof Schütte, and Eric Vanden-Eijnden),  
*J. Chem. Phys.* **134**, 204105 (2011).
- A fast parallel algorithm for selected inversion of structured sparse matrix with application to 2D electronic structure calculations  
(with Weinan E, Lin Lin, Chao Yang, and Lexing Ying), *SIAM J. Sci. Comput.* **33**, 1329–1351 (2011).
- Fast construction of hierarchical matrix representation from matrix-vector multiplication  
(with Lin Lin and Lexing Ying), *J. Comput. Phys.* **230**, 4071–4087 (2011).
- Frozen Gaussian approximation for high frequency wave propagation  
(with Xu Yang), *Commun. Math. Sci.* **9**, 663–683 (2011).
- Synchrosqueezed wavelet transforms: a tool for empirical mode decomposition  
(with Ingrid Daubechies and Hau-Tieng Wu), *Appl. Comp. Harmonic Anal.* **30**, 243–261 (2011).
- Effective Maxwell equations from time-dependent density functional theory  
(with Weinan E and Xu Yang), *Acta Math. Sin.* **32**, 339–368 (2011).  
Special issue dedicated to Professor Hua Loo-Keng on his 100th birth anniversary.
- The electronic structure of smoothly deformed crystals: Wannier functions and the Cauchy-Born rule  
(with Weinan E), *Arch. Ration. Mech. Anal.* **199**, 407–433 (2011).
- SellInv - an algorithm for selected inversion of a sparse symmetric matrix  
(with Weinan E, Lin Lin, Juan Meza, Chao Yang, and Lexing Ying),  
*ACM Trans. Math. Software* **37**, article no. 40 (2011).
- The electronic structure of smoothly deformed crystals: Cauchy-Born rule for nonlinear tight-binding model  
(with Weinan E), *Comm. Pure Appl. Math.* **63**, 1432–1468 (2010).
- Localized basis of eigen-subspaces and operator compression  
(with Weinan E and Tiejun Li), *Proc. Natl. Acad. Sci. USA* **107**, 1273–1278 (2010).
- Fast algorithm for extracting the diagonal of the inverse matrix with application to the electronic structure analysis of metallic systems  
(with Roberto Car, Weinan E, Lin Lin, and Lexing Ying), *Commun. Math. Sci.* **7**, 755–777 (2009).
- Pole-based approximation of the Fermi-Dirac function  
(with Weinan E, Lin Lin, and Lexing Ying), *Chin. Ann. Math. Ser. B* **30**, 729–742 (2009).  
Special issue dedicated to Professor Andrew Majda on the occasion of his 60th birthday.
- Multipole representation of the Fermi operator with application to the electronic structure analysis of metallic systems  
(with Roberto Car, Weinan E, and Lin Lin), *Phys. Rev. B* **79**, 115133 (2009).
- A linear scaling subspace iteration algorithm with optimally localized non-orthogonal wave functions for Kohn-Sham density functional theory  
(with Weinan E, Carlos J. García-Cervera, and Yulin Xuan), *Phys. Rev. B* **79**, 115110 (2009).
- Sequential multiscale modelling using sparse representation  
(with Weinan E, Carlos J. García-Cervera, and Weiqing Ren), *Commun. Comput. Phys.* **4**, 1025–1033 (2008).  
Special issue dedicated to Professor Xiantu He on the occasion of his 70th birthday.



## INVITED CONFERENCE PRESENTATIONS

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- SEP 2011 Workshop on Pattern Formation and Multiscale Phenomena in Materials, University of Oxford, Oxford, United Kingdom
- JUL 2011 Minisymposium on Mathematical Aspects of Solids and Solid Mechanics, Minisymposium on Atomistic/Continuum Multiscale Methods, Minisymposium on Challenges and Novel Techniques in Computational Chemistry, ICIAM 2011, Vancouver, Canada
- JUN 2011 Workshop on Mathematical Methods in Quantum Chemistry, Oberwolfach, Germany
- JUN 2011 International Conference on Interdisciplinary Applied Mathematics and Computational Mathematics, Zhejiang University, Hangzhou, China
- JUN 2011 Summer Program on Electronic Structure Analysis and Computation, Shanghai Jiao Tong University, Shanghai, China
- JAN 2011 Tutorial talk, BIRS Workshop on Density Functional Theory, Banff, Canada
- OCT 2010 Symposium on Mathematical Methods, Fifth International Conference on Multiscale Materials Modeling (MMM2010), Freiburg, Germany
- AUG 2010 Workshop on Computational Problems in Material Sciences, Suzhou, China
- MAY 2010 Minisymposium on Multiscale Modeling of Material Interfaces, SIAM Conference on Mathematical Aspects of Materials Science (SIAM MS10), Philadelphia
- NOV 2009 Fifth International Workshop on High Performance Computing for Nano-science and Technology (HPCNano09), Supercomputing09, Portland
- SEP 2009 Courant Instructor Day, New York University, New York
- JUL 2009 Working Session on Density Functional Theory, Berlin, Germany
- MAR 2009 Minisymposium on Large Scale ab initio Electronic Structure and Molecular Dynamics Computations, SIAM Conference on Computational Science and Engineering (SIAM CSE09), Miami
- DEC 2008 International Workshop on Time-Frequency Analysis and its Applications, Guangzhou, China
- MAY 2008 Minisymposium on Electronic Structure, SIAM Conference on Mathematical Aspects of Materials Science (SIAM MS08), Philadelphia
- APR 2008 Workshop on Atomistic Models of Materials: Mathematical Challenges, Oberwolfach, Germany

## COLLOQUIUM AND SEMINAR TALKS

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- FEB 2012 Colloquium, Harvard School of Engineering and Applied Science, Harvard University
- FEB 2012 Applied Math Seminar, University of Utah
- FEB 2012 Colloquium, University of Utah
- FEB 2012 Colloquium, Michigan State University
- JAN 2012 Department of Mathematics Seminar, Duke University
- JAN 2012 Colloquium, University of California, Irvine
- JAN 2012 Colloquium, University of California, Santa Barbara
- JAN 2012 Applied Math Seminar, University of California, Berkeley
- JAN 2012 Colloquium, University of California, San Diego
- JAN 2012 Colloquium, University of Illinois at Urbana-Champaign
- JAN 2012 Colloquium, North Carolina State University
- DEC 2011 Applied Math Colloquium, Columbia University
- DEC 2011 Colloquium, Indiana University
- DEC 2011 Colloquium, Purdue University
- DEC 2011 Colloquium, Northeastern University
- DEC 2011 Colloquium, Georgia Institute of Technology
- NOV 2011 Colloquium, Carnegie Mellon University
- NOV 2011 Joint Analysis and Numerical Analysis Seminar, University of Texas at Austin
- NOV 2011 Colloquium, University of Wisconsin-Madison
- NOV 2011 Numerical Analysis Seminar, Courant Institute, New York University
- NOV 2011 Imaging and Computing Seminar, MIT
- NOV 2011 Probability Seminar, Division of Applied Mathematics, Brown University
- OCT 2011 Colloquium, Department of Mathematics, Technische Universität Berlin
- OCT 2011 Angewandte Analysis Seminar, Max Planck Institute for Mathematics in the Sciences, Leipzig
- JUN 2011 Joint Seminar, Institute of Natural Sciences, Shanghai Jiao Tong University
- MAY 2011 Seminar, Institute of Computational Mathematics, Chinese Academy of Sciences
- MAY 2011 Computational Science Seminar, School of Mathematics, Peking University
- MAR 2011 ICES/Numerical Analysis Seminar, University of Texas at Austin

JAN 2011 Analysis Seminar, Max Planck Institute for Mathematics in the Sciences, Leipzig  
JUL 2010 Seminar, Institute of Computational Mathematics, Chinese Academy of Sciences  
APR 2010 Applied Math Seminar, Courant Institute, New York University  
FEB 2010 ICES/Numerical Analysis Seminar, University of Texas at Austin  
NOV 2009 Applied Math and PDE Seminar, University of California, Santa Barbara  
OCT 2009 Applied Math Seminar, Courant Institute, New York University  
MAY 2009 Numerical Analysis Seminar, University of Texas at Austin  
FEB 2009 Applied Math Colloquium, University of Pennsylvania  
DEC 2008 Computational Science Seminar, School of Mathematics, Peking University

## SERVICES

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### Referee for

Appl. Comp. Harmonic Anal.; Comm. Pure Appl. Math.; Commun. Math. Sci.;  
IEEE Trans. Signal Proc.; J. Amer. Math. Soc.; J. Comput. Phys.; J. Mech. Phys. Solids;  
Multiscale Model. Simul.; Phys. Rev. B; Proc. R. Soc. A; SIAM J. Math. Anal.;  
SIAM J. Numer. Anal.; SIAM J. Sci. Comput.

EUROPEAN RESEARCH COUNCIL ADVANCED GRANTS

2011 top referee award for Proceedings of the Royal Society A

### Co-Organizer of

Computational Statistical Mechanics Seminar,  
Courant Institute, New York University, 2011–

Summer program on Electronic Structure Analysis and Computation,  
Shanghai Jiao Tong University, China, Summer 2011

Member of NATIONAL OLYMPIAD IN INFORMATICS (NOI) Scientific Committee,  
Chinese Computer Federation, 2003–2005