

# HONGJIE DONG

Assistant Professor of Applied Mathematics  
Division of Applied Mathematics  
Brown University

## Address

Division of Applied Mathematics  
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## Research Interests

Partial Differential Equations: Nonlinear elliptic and parabolic PDEs, Navier-Stokes equations, quasi-geostrophic equations, reaction diffusion equations, unique continuation problems.

Probability: Probabilistic approach of PDEs, stochastic processes, stochastic control theory.

Numerical Analysis: Rates of convergence of finite difference approximations.

## Education

University of Minnesota: 2001.9–2005.8. Ph.D. in Mathematics.

Ph.D. thesis: “On some problems related to the regularity theory for second-order elliptic-parabolic equations and their numerical approximations.”

Thesis advisor: Professor Nicolai V. Krylov.

Fudan University: 1997.9–2001.7. B.S. in Mathematics.

B.S. thesis: “On the compatibility condition of a system of nonlinear first order partial differential equations and its connection to the Frobenius theorem.”

Thesis advisor: Professor Jiaying Hong.

## Experience and Employment

Brown University: 2007.7– present. Assistant Professor of Applied Mathematics.

Mathematical Sciences Research Institute: 2007.7–2007.8

*Member of the “MSRI Summer Microprogram on Nonlinear Partial Differential Equations”.*

Institute for Advanced Study: 2006.9–2007.6

*Postdoctoral Member.* University of Chicago: 2005.9–2006.8 *L.E. Dickson Instructor.*

2006 Lecture, Math 275 (Basic Theory of Partial Differential Equations)

2006 Lecture, Math 201 (Math Methods For Physical Sciences-2)

2006 Lecture, Math 200 (Math Methods For Physical Sciences-1)

2005 Lecture, Math 200 (Math Methods For Physical Sciences-1)

University of Minnesota: 2001.9–2005.8.

*Research Assistant of Prof. Nicolai V. Krylov.*

*Teaching Assistant.*

2005 Teaching Assistant, Math 2243 (Linear Algebra and Differential Equations),

2004 Teaching Assistant, Math 2243 (Linear Algebra and Differential Equations),

2002 Teaching Assistant, Math 1272 (Calculus II),

2002 Teaching Assistant, Math 2374 (Multivariable Calculus and Vector Analysis),

2001 Teaching Assistant, Math 1272 (Calculus II).

Fudan University: 1997.9–2001.7.

*Member of university funded programs in applied math:*

Computer-aid realization of Conformal maps, under Prof. Jinghao Zhang.

Optimization of errors in rapid prototyping, under Prof. Yuan Cao.

## **Publications**

- About smoothness of solutions of the heat equations in closed smooth space-time domains, *Comm. Pure Appl. Math.* 58 (2005) no. 6, 799–820.
- On the rate of convergence of finite-difference approximations for Bellman's equations with constant coefficients, with N.V. Krylov, *Algebra i Analis (St. Petersburg Math.J.)* 17 (2005), no. 2, 108–132.

- On the local smoothness of solutions of the Navier-Stokes equations, with D. Du, *J.Math. Fluid Mech.* 9 (2007), no. 2, 139–152.
- Rate of convergence of finite-difference approximations for degenerate linear parabolic equations with  $C^1$  and  $C^2$  coefficients, with N.V. Krylov, *Electro. J. Differential Equations* 2005 (2005), no. 102, 1–25.
- On some problems related to the regularity theory for second-order elliptic-parabolic equations and their numerical approximations, Ph.D thesis (2005), advisor: N.V. Krylov.
- Hessian equations with elementary symmetric functions, *Comm. Partial Differential Equations.* 31 (2006) no. 7, 1005–1025.
- On time inhomogeneous controlled diffusion processes in domains, with N.V. Krylov, *Annal. Prob.* 35, no. 1 (2007), 206–227.
- On the rate of convergence of finite-difference approximations for Bellman equations with Lipschitz coefficients in domains, with N.V. Krylov, *Appl. Math. Optim.*, 56, (2007) no. 1, 37–66.
- On unique continuation for the schrödinger equation with gradient vector potentials, with W. Staubach, *Proc. Amer. Math. Soc.* 135 (2007), no. 7, 2141–2149.
- On uniqueness of boundary blow-up solutions of a class of nonlinear elliptic equations, with S. Kim and M.V. Safonov, *Comm. Partial Differential Equations*, to appear (2006).
- Partial regularity of weak solutions of the Navier-Stokes equations in  $\mathbb{R}^4$  at the first blow-up time, with D. Du, *Comm. Math. Phys.*, 273, (2007) no. 3, 785–801.
- Higher regularity for the critical and super-critical dissipative quasi-geostrophic equations, submitted (2006).
- Spatial analyticity of the solutions to the sub-critical dissipative Quasi-geostrophic equations, with D. Li, accepted by *Arch. Rational Mech. Anal.* (2006).
- Optimal local smoothing and analyticity rate estimates for the generalized Navier-Stokes equations, with D. Li, submitted (2007).
- Global well-posedness and a decay estimate for the critical dissipative quasi-geostrophic equation, with D. Du, submitted (2007).
- Finite time singularities for a class of generalized surface quasi-geostrophic equations, with D. Li, accepted by *Proc. Amer. Math. Soc.*
- A note on a certain type of traveling waves in cylinders, in preparation.

- On the 2D critical and supercritical dissipative quasi-geostrophic equation in Besov spaces, with D. Li, preprint.
- On the fundamental solutions for strongly parabolic systems of second order, with S. Cho and S. Kim, submitted.
- Green's matrices of second order elliptic systems with measurable coefficients in two dimensional domains, with S. Kim, preprint.
- On the well-posedness for a transport equation with nonlocal velocity, submitted.

### **Honors and Awards**

MSRI Membership: 2007.7–2007.8.

IAS Membership: 2006–2007.

Travel Grants from AMS for ICM 2006, Madrid, Spain: August 22-30, 2006.

Outstanding Graduate: Fudan University, 2001.

The First, Second Prizes of People's Scholarship: Fudan University, 1998-2001.

Meritorious Winner of Mathematical Contest in Modeling: The Consortium for Mathematics and its Applications, 2000.

Perfect Paper on the American Invitational Mathematics Examination: The Mathematical Association of America, 1997.

The First Prize of Chinese Mathematical Olympiad: rank top 4 in P. R. China, 1997.

The First, Second Prizes: in Contests of Mathematics, Physics and Chemistry, 1991–1997.

### **Conference and Workshop Talks**

- MSRI Summer Microprogram on Nonlinear Partial Differential Equations, MSRI, Berkeley, CA, July 23, 2007 to August 10, 2007. *On the Green's matrices of strongly elliptic and parabolic systems of second order.*
- Asymptotic Analysis in Stochastic Processes, Nonparametric Estimation and Related Problems, Wayne State University, Detroit, MI, September 16, 2006. *On time inhomogeneous controlled diffusion processes in domains.*

- Probabilistic and Analytical Perspectives on Contemporary PDEs, Carnegie Mellon University, Pittsburgh PA, May 29, 2006. *About smoothness of solutions of the heat equations in closed smooth space-time domains.*
- Frontiers of Applied Analysis, Carnegie Mellon University, Pittsburgh PA, Sept. 9, 2005. *Rate of convergence of finite-difference approximations for Bellman's equations with constant coefficients.*
- International Summer School on Fully Nonlinear Partial Differential Equations and Applications, Zhejiang University, June 7, 2005. *Hessian equations with elementary symmetric functions.*
- Statistics, Numerical Analysis, II, AMS/MAA Joint meeting, Atlanta, Georgia, January 6, 2005. *Rate of convergence of finite-difference approximations for Bellman's equations with constant coefficients.*

### **Seminar Talks**

- *Ergodic Theory and Statistical Mechanics Seminar*, Princeton University, March 8, 2007.
- *Mathematical physics seminar*, IAS, February 21, 2007.
- *Nonlinear Analysis and PDEs Seminar*, Rutgers University, February 13, 2007.
- *School of Mathematical Sciences*, Fudan University, January 8, 2007.
- *PDE/Applied Math Seminar*, University of Maryland, December 14, 2006.
- *Special Talk – Stochastic Systems Seminar*, Brown University, December 5, 2006.
- *PDE Seminar*, Brown University, December 1, 2006.
- *Analysis Seminar*, Princeton University, November 27, 2006.
- *PDE Seminar*, University of Minnesota, November 8, 2006.
- *Talks by Postdoctoral Members*, Institute for Advanced Study, October 11, 2006.
- *PDE Seminar*, Northwestern University, Evanston IL, May 11, 2006.
- *Calderón-Zygmund Analysis Seminar*, University of Chicago, Chicago IL, May 1, 2006.
- *Calderón-Zygmund Analysis Seminar*, University of Chicago, Chicago IL, Oct. 24, 2005.

- *Applied Mathematics and Numerical Analysis Seminar*, University of Minnesota, February 24, 2005.

- *PDE Seminar*, University of Minnesota, November 6, 2004.

### **Other Professional Activities**

Membership, American Mathematical Society.

### **Journals Refereed**

*Math. Comp.*

*Appl. Math. Optim.*

*Numer. Math.*

*SIAM J. Control Optim.*

*Int. Math. Res. Not.*