

# Curriculum Vitae

Wen Shen

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## Personal information:

- Born on January 27, 1968 in Shanghai, P. R. China.
- Married with Alberto Bressan, two daughters Luisa Mei Bressan (1998) and Maria Lan Bressan (2001).
- Languages: Chinese(native), English, Norwegian and Italian
- Nationality: Italian(present), Chinese(previous).

## Research interests:

- Partial differential equations(PDE), in particular hyperbolic conservation laws, theories (relaxation, viscosity solutions), numerics (reservoir simulation) and applications (differential games and granular matters);
- Discontinuous ordinary differential equations (ODE);
- Control theory and differential games;

## Education and professional positions: (from past to present)

- 08.1986–06.1990: Shanghai Jiao Tong University, China. Majored in Electrical Engineering. Degree: Bachelor of Science.
- 07.1990–12.1990: Shanghai Xing Dong High-Tech. Co., Shanghai, China. Researcher.
- 01.1991–12.1991: University of Oslo, Norway. Intensive Norwegian courses.
- 01.1992–06.1993: Department of Informatics, University of Oslo, Norway. Majored in Informatics. Degree: Cand. mag. (Bachelor of Science).
- 08.1993–06.1994: Department of Informatics, University of Oslo, Norway. Majored in Informatics. Degree: Cand. Scient. (Master of Science).
- 01.1993–08.1994: Teaching assistant at Department of Informatics, University of Oslo, Norway.

- 09.1994–09.1998: Research fellow in Applied Mathematics(numerical analysis), Informatics. Department of Informatics, University of Oslo, Norway. Degree: Cand. Scient. (Ph.D).
- 12.1996–03.1997 and 12.1997–05.1998: Visiting Scientist, S.I.S.S.A., Sector for Functional Analysis, Italy.
- 09.1998–07.2000: maternal leave.
- 08.2000–05.2001: Associate Professor, Department of Mathematics, NTNU (Norwegian University of Science and Technology), Trondheim, Norway.
- 06.2001–10.2002: maternal leave.
- 11.2002–11.2003: Research Associate, sector of functional analysis, SISSA, Trieste, Italy.
- 11.2003–06.2009: Assistant Professor of Mathematics, Department of Mathematics, Penn State University, University Park, PA 16802, U.S.A..
- 06.2009–present: Associate Professor of Mathematics, Department of Mathematics, Penn State University, University Park, PA 16802, U.S.A..

**Publications:**

Research papers and proceeding papers: (from present to past):

1. DEBORA AMADORI AND WEN SHEN, Mathematical Aspects of a Model for Granular Flow, Preprint, 2009. Submitted to IMA. (10 pages)
2. DEBORA AMADORI AND WEN SHEN, A Hyperbolic Model of Granular Flow. Preprint 2009. Submitted to CAS. (21 pages)
3. DEBORA AMADORI AND WEN SHEN, The Slow Erosion Limit in a Model of Granular Flow. Preprint 2008. Submitted to *Archive for Rational Mechanics and Analysis*. (28 pages)
4. DEBORA AMADORI AND WEN SHEN, Global Existence of Large BV Solutions in a Model of Granular Flow. *Communications on Partial Differential Equations*, **34** (2009), no. 7-9, 1003-1040.
5. ALBERTO BRESSAN AND WEN SHEN, Measure Valued Solutions to a Harvesting Game with Several Players. Accepted for publication in the XIth *Annals of ISDG (International Symposium of Dynamical Games)*, (23 pages)

6. WEN SHEN, Non-Cooperative and Semi-Cooperative Differential Games, in *Advances in Dynamic Games and their Applications; Analytical and Numerical Developments. Series: Annals of ISDG (International Symposium of Dynamical Games)*, vol. 10. Editors: Pierre Bernhard, Gaitsgory Vladimir, Odile Pourtallier. Birkehauser (2009). pp. 85-106.
7. ALBERTO BRESSAN AND WEN SHEN, Measure Valued Solutions for a Differential Game Related to Fish Harvesting. *SIAM (Society for Industrial and Applied Mathematics) Journal on Control and Optimization*, Volume 47, Issue 6, (2009), pp. 3118-3137.
8. WEN SHEN, On a Model of Granular Flow. In "*Hyperbolic Problems: Theory, Numerics and Applications*", Proceedings of the 12th International Conference on Hyperbolic Problems held in University of Maryland, College Park, USA, June 9-13 2008. Eds: Eitan Tadmor, Jian Guo Liu, Athanasios Tzavaras. AMS 2009, p. 939-948.
9. WEN SHEN, On the Shape of the Avalanche. *Journal of Mathematical Analysis and Applications*, **339** (2008) 828-838.
10. WEN SHEN AND ZHENGFU XU, Vanishing Viscosity Approximation to Hyperbolic Conservation Laws, *Journal of Differential Equations*, **244** (2008), no. 7, 1692-1711.
11. WEN SHEN, Finite Dimensional Representation of Hyperbolic Conservation Laws with Viscosity, In "*Hyperbolic Problems: Theory, Numerics and Applications*", Proceedings of the Eleventh International Conference on Hyperbolic Problems held in Ecole Normale Superieure, Lyon, July 17-21, 2006. Editors: Sylvie Benzoni-Gavage and Denis Serre. pp. 981-988. Springer, 2008.
12. A. BRESSAN AND W. SHEN, Optimality Conditions for Solutions to Hyperbolic Balance Laws In "*Control Methods in PDE and Dynamical Systems*", F. Ancona and R. Triggiani eds., AMS Contemporary Mathematics Series 426, (2007) pp. 129-152.
13. W. SHEN AND M. PARK, Optimal Tracing of Viscous Shocks in Solutions of Viscous Conservation Laws, *SIAM (Society for Industrial and Applied Mathematics) Journal on Mathematical Analysis* **38**, No. 5 (2007) pp. 1474-1488.
14. A. BRESSAN AND W. SHEN, Unique Solutions of Discontinuous O.D.E.'s in Banach Spaces, *Analysis and Applications*, Vol. 4, No. 3 (2006), pp. 247-262.
15. ALBERTO BRESSAN AND WEN SHEN, Non-cooperative Differential Games, in "*Hyperbolic Problems: Theory, Numerics and Applications*", Proceedings of the

Tenth International Conference on Hyperbolic Problems. pp. 77-84. F. Asakura ed., Yokohama Publishers, 2006.

16. A. BRESSAN AND W. SHEN, Semi-cooperative Strategies for Differential Games, *International Journal of Game Theory*, **32** (2004), pp. 561–593.
17. A. BRESSAN AND W. SHEN, Small BV Solutions of Hyperbolic Non-cooperative Differential Games, *SIAM (Society for Industrial and Applied Mathematics) Journal on Control and Optimization*, **43** (2004), pp. 104–215.
18. A. M. BRUASET, X. CAI, H. P. LANGTANGEN, G. T. LINES, K. SAMUELSSON, W. SHEN, A. TVEITO, G. ZUMBUSCH, Performance modeling of PDE solvers, In H. P. Langtangen and A. Tveito, editors, *Advanced Topics in Computational Partial Differential Equations – Numerical Methods and Diffpack Programming*. Springer-Verlag, pp. 361-399. Lecture Notes in Computational Science and Engineering, 2003.
19. ALBERTO BRESSAN AND WEN SHEN, The convergence of Multicomponent chromatography with relaxation, in "Hyperbolic Problems: Theory, Numerics and Applications". *Proceeding of HYP2000 in Magdeburg* (2001), Birkhäuser Verlag Basel, pp.197-205.
20. A. BRESSAN AND W. SHEN, BV estimates for multicomponent chromatography with relaxation, *Discrete and Continuous Dynamical Systems*, The Millennium Issue, **6** (2000), pp.21-38.
21. W. SHEN, A. TVEITO AND R. WINTHER, On the zero relaxation limit for a system modeling the motions of a viscoelastic solid, *SIAM (Society for Industrial and Applied Mathematics) Journal on Mathematical Analysis*, **30** (1999), pp. 1115–1135.
22. W. SHEN, Error bounds of finite difference schemes for two-dimensional scalar conservation with source terms, *IMA (The Institute of Mathematics and its Applications) Journal of Numerical Analysis*, **19** (1999), pp. 77–89.
23. WEN SHEN, ASLAK TVEITO AND RAGNAR WINTHER, Rate of convergence for the zero relaxation limit, in "Hyperbolic Problems: Theory, Numerics, Applications", the proceedings of the 7th Int. Conf. on Hyperbolic Problems. Editors: M. Fey and R. Jeltsch, International Series of Numerical Mathematics, Vol. 130, pp. 865-874, Birkhäuser Verlag Basel, Switzerland, 1999.
24. A. BRESSAN, W. SHEN, On Discontinuous Differential Equations, *Differential Inclusions and Optimal Control*, Lecture Notes in Nonlinear Analysis, **2** (1998), pp. 73–87.

25. A. BRESSAN, W. SHEN, Uniqueness for discontinuous ODEs and conservation laws, *Nonlinear Analysis, Theory, Methods, and Applications*, **34** (1998), pp. 637–652.
26. W. SHEN, A. TVEITO AND R. WINTHER, A system of conservation laws including a stiff relaxation term; the 2D case, *Bit*, **36:4** (1996), pp. 786–813.

Thesis:

1. W. SHEN, *Hyperbolic Conservation Laws with Relaxation Terms*, PhD. Thesis, Department of Informatics, University of Oslo, Norway. March 30, 1998. Advisors: Professor Aslak Tveito and Professor Ragnar Winther.
2. W. SHEN, *Numerical Solution of the Pressure Equation in a Simple Model of Aluminium DC-casting*, Thesis for Cand. Scient. Degree(Master of Science) in Informatics, Department of Informatics, University of Oslo, Norway, and Section for Applied Mathematics, SINTEF, Oslo, Norway. April 1994. Advisor: Professor Aslak Tveito.

Research reports:

1. A.M. BRUASET, X. CAI, H.P. LANGTANGEN, G.T. LINES, K. SAMUELSSON, W. SHEN, A. TVEITO AND G. ZUMBUSCH, CPU-measurements of some numerical PDE simulations, Technical report, Preprint no. 1998-3, Department of Informatics, University of Oslo, Norway.
2. W. SHEN, A comparison between two finite element methods for the solution of a simplified model of alloy casting, Research Report, ISBN 82-7368-121-1, ISSN 0806-3036, December 1995, Department of Informatics, University of Oslo, Norway.
3. W. SHEN AND A. M. BRUASET, Mixed Finite Element Solution of Elliptic Boundary Value Problems, SINTEF-report no. STF33 A94018, Section for Applied Mathematics, SINTEF, Oslo, Norway, 1994.
4. H.P. LANGTANGEN, G. PEDERSEN AND W. SHEN, *Finite Element Preprocessors in Diffpack*, SINTEF-report no. STF33 A94051, Section for Applied Mathematics, SINTEF, Oslo, Norway, 1994.
5. H. THEVIK, A. MO, W. SHEN, To-dimensjonale strøminingseffekter ved utsvettning under DC-støping, (in Norwegian), SINTEF-report no. STF24 F94064, Section for Applied Mathematics, SINTEF, Oslo, Norway, 1994.

### Grants and Awards:

- NSF grant, DMS - 0908047, titled “Mathematical Aspects of Some PDE Models for Granular Matter and Fish Harvest”. Sole PI: Wen Shen. Period: 8/15/2009 – 8/14/2012.
- SCREMS Grant from NSF(National Science Foundation), 2006-2007. I am a co-PI(Primary Investigator).
- Mary Lister McCammon Award for Distinguished Undergraduate Teaching in Mathematics, Penn State University, April 2007.

### Selected Recent Talks:

- July 2009, IMA, University of Minnesota, *Recent results on a model for granular flow*, invited lecture to the Summer Program on Nonlinear Conservation Laws and Applications, July 13-31, 2009.
- August 28 2008, *Global existence of BV solutions and Slow Erosion Limit for a model of Granular Flow*. invited talk at CBC (Center for Biomedical Computing), Simula Research Laboratory, Oslo, Norway.
- August 20-22, 2008, *On a Model of Granular Flow*, invited speaker at Workshop on Nonlinear Waves and Hyperbolic Equations, Centre for Advanced Study (CAS), University of Oslo, Norway.
- June 9, 2008, *On a Model of Granular Flow*, Invited talk given at Department of Mathematics of Brescia University, Italy.
- June 30th-July 4th, 2008, *Measure Valued Solutions for a Differential Game Related to Fish Harvesting*, invited talk at 13-th International Symposium on Dynamic Games and Applications, Wroclaw University of Technology, Wroclaw, Poland.
- June 9-13 2008, *The Slow Erosion Limit for a Model of Granular Flow*, at “*Hyperbolic Problems: Theory, Numerics and Applications*”, Proceedings of the 12th International Conference on Hyperbolic Problems held in University of Maryland, College Park, USA, June 9-13 2008.
- September 22-24, 2006, *Finite Dimensional Representation of Hyperbolic Conservation laws with viscosity*. invited speaker, Midwest PDE Seminar, University of Iowa, Iowa City, Iowa.
- July 3-6, 2006, *Non-cooperative and semi-cooperative differential games*, invited lecture, ISDG Symposium, session on non-zero games. Inria, Sophia Antipolis, French Riviera, France.

- July 17-21, 2006, *Optimal Tracing of Viscous Shocks in Solutions of Conservation Laws*, Eleventh International Conference on Hyperbolic Problems (Theory, Numerics, Applications), Ecole Normale Supérieure de Lyon, Lyon, France.
- March 2005, Georgia Tech, USA. “*Non-cooperative and semi-cooperative differential games*”.
- Nov 2004, AMS meeting, Pittsburg, Pennsylvania. “*Semi cooperative differential games.*”
- Aug 2003, Dept of Math, NTNU, Trondheim, Norway. “*Small BV solutions of hyperbolic non-cooperative differential games*”.
- Aug 2003, Department of Mathematics, University in Oslo, Oslo, Norway. “*Topics on Differential Games*”.
- June 2003, SISSA/ISAS, Trieste, Italy. “*Non-cooperative differential games*”.
- October 2000, *BV estimate and convergence for multi-component chromatography with relaxation*, Oberwolfach, Germany.
- March 2000, *The convergence of Multicomponent chromatography with relaxation*, “Hyperbolic Problems: Theory, Numerics, Applications”, the 8th Int. Conf. on Hyperbolic Problems, Magdeburg, Germany.
- February 1998, *Rate of convergence for the zero relaxation limit*, invited lecture, “Hyperbolic Problems: Theory, Numerics, Applications”, the 7th Int. Conf. on Hyperbolic Problems, Zurich, Switzerland. (presented by R. Winther)
- June 1996, *Error bounds of finite difference schemes for two-dimensional scalar conservation with source terms* “Hyperbolic Problems: Theory, Numerics, Applications”, the 6th Int. Conf. on Hyperbolic Problems, Hong Kong.

### **Teaching:**

Teaching in Norway, in Norwegian:

- Fall 2000, SIF 4050, “Mathematics 4”, 4 credits, Institute for Mathematics, NTNU (Norwegian University of Science and Technology), Trondheim, Norway.
- Spring 2001, SIF 5040, “Numerical Computation”, 3 credits, Institute for Mathematics, NTNU (Norwegian University of Science and Technology), Trondheim, Norway.

Teaching at Penn State University:

- Spring 2004, MATH/CSE 451, “Numerical Computation”, section 1 and 2, 3 credits each section (total 6 credits).

- Fall 2004, MATH 250, “Ordinary Differential Equations”, section 5 and 6. 3 credits each section (total 6 credits).
- Spring 2005, MATH/SCE 451, “Numerical Computation”, section 2, 3 credits.
- Spring 2006, MATH 140, Calculus I, section 2 and 4, 4 credits each section (total 8 credits).
- Fall 2006, MATH 231, Calculus of Several Variables, section 4 and 6, 2 credits each (total 4 credits).
- Spring 2007, MATH 597C, Numerical Methods for Hyperbolic Conservation Laws. Graduate Topic Course. 3 credits.
- Fall 2007, MATH 405, section 1 and 2, Advanced Calculus for Eng/Sci, I . 3 credits each section (total 6 credits).
- Spring 2008, Math 524, Numerical Analysis II. Graduate qualify sequence course. 3 credits.
- Spring 2009, MATH 250, sections 1, 2 and 6, Ordinary Differential Equations, 3 credits each section (total 9 credits).
- Fall 2009, MATH 230, sections 2 and 6, Vector Calculus, 4 credits each section (total 8 credits).

### **Service to the Department.**

- Member of the Faculty of Graduate School.
- GTA (Graduate Teaching Assistants) Oversight Committee, from 2004 to present.
- Course coordinator for MATH 250, fall 2004.
- Member of the PhD Thesis Defense Committee for Maria Emelainenko, 2005.
- Meeting organizer for WIM (Women In Mathematics), 2005 and 2006.
- Committee member for qualifying exam in Partial Differential Equations, August 2004.
- Committee member for qualifying exams in numerical analysis, May 2006.
- Committee member for qualifying exams in numerical analysis, August 2006.
- Course coordinator for MATH231, fall 2006.
- One of the local organizer for FE Circus, Penn State, November 3-4, 2006.

- Co-advisor for a female graduate student M.R. Park (She graduated with Master Degree in August 2006).
- Mentor for post-doc Zhengfu Xu.
- Committee member for qualifying exams in numerical analysis, May 2008.
- Course coordinator for MATH 250, spring 2009.
- Course coordinator for MATH 230, fall 2009.

**Service to the Profession.**

- Reviewer for AMS “Mathematical Reviews”;
- Referee for SIAM (Society for Industrial and Applied Mathematics) Journal of Control and Optimization, Numerical Methods In Partial Differential Equations Journal, Mathematics of Computation, SIAM Journal on Scientific Computing. etc;
- On the Editorial Board of the Online Journal entitled: “Journal of Advanced Researches on Dynamical and Control Systems (e-ISSN: 1943-023X)”.
- Reviewer for book proposals for the publishers, Wiley and Pearson.