

# CURRICULUM VITAE

PENGFEEI GUAN

## Address:

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## Education:

Ph.D in Mathematics (1989), Princeton University (advisor: J.J. Kohn).  
M.S. in Mathematics (1986), Princeton University.  
B.S. in Mathematics (1982), Zhejiang University, China.

## Awards:

Alfred P. Sloan Fellowship (1993-1995).

## Honors:

Canada Research Chair (tier I, 2005-),  
Fellow of Royal Society of Canada (inducted in 2008).  
Queen Elizabeth II Diamond Jubilee Medal (2012)

## Employment:

Assistant Professor (1989-1993, McMaster University)  
Associate Professor (1993-1997, McMaster University)  
Professor (1997-2004, McMaster University).  
Professor (2004-, McGill University)

## Research Interest:

Nonlinear Partial Differential Equations and Geometric Analysis.

## Research Fundings:

NSERC: 1990-2018.

**Publication:**

- (1) P. Guan and J. Li, *A Fully nonlinear flow and quermassintegral inequalities*, to appear in Special Issue dedicate to 90th birthday of Professor Guangchang Dong, Science China Mathematics.
- (2) P. Guan and S. Lu, *Curvature estimates for immersed hypersurfaces in Riemannian manifolds*, Inventiones Mathematicae, V.208, (2017), 191-215.
- (3) B. Andrews, P. Guan and L. Ni, *Flow by the power of the Gauss curvature*. Advances in Mathematics, V. 299, (2016), 174-201.
- (4) P. Guan, P. Lu and Y. Xu, *A rigidity theorem for codimension one shrinking gradient Ricci solitons in  $\mathbb{R}^{n+1}$* , Calculus of Variations and PDEs, Volume 54, pp 4019-4036, 2015
- (5) P. Guan and L. Ni, *Entropy and a convergence theorem for Gauss curvature flow in high dimension*, to appear in Journal of European Mathematical Society. (<https://www.ems-ph.org/journals/forthcoming.php?jrn=jems>)
- (6) P. Guan, Z. Wang and X. Zhang, *A proof of the Alexanderov's uniqueness theorem for convex surfaces in  $\mathbb{R}^3$* , Ann. Inst. H. Poincare Anal. Non Lineaire, V. 33 (2016), 329-336.
- (7) P. Guan and X. Shen, *A Rigidity Theorem for hypersurfaces in higher dimensional space forms*, Contemporary Mathematics, AMS. V.644, 2015. pp. 61-65.
- (8) P. Guan and J. Li, *A mean curvature flow in space form*, International Mathematics Research Notices, Vol. 2015, NO. 13, (2015) 4716-4740.
- (9) P. Guan, C. Ren and Z. Wang, *Global  $C^2$  estimates for convex solutions of curvature equations*, Communications on Pure and Applied Mathematics. V. 68, (2015), 1287-1325,
- (10) P. Guan and L. Xu, *Convexity estimates for level sets of quasiconcave solutions to fully nonlinear elliptic equations*. Journal fur die reine und angewandte Mathematik reine angew.V.680, (2013) 41-67.
- (11) P. Guan and X. Zhang, *Regularity of the geodesic equation in the space of Sasakian metrics*, Advances in Mathematics, Volume 230, (2012) 321-371.
- (12) P. Guan and D. Phong, *A maximum rank problem for degenerate elliptic fully nonlinear equations*, Math. Ann. 354 (2012), 147-168.
- (13) P. Guan, J. Li and Y.Y. Li, *Hypersurfaces of prescribed curvature measures*, Duke Math. Journal, Vol. 161, No. 10 (2012), 1927-1942.
- (14) P. Guan and D. Phong, *Partial Legendre transforms of nonlinear equations*. Proc. AMS. , 140 (2012), 3831-3842.
- (15) B. Bian, P. Guan, X. Ma and L. Xu, *A constant rank theorem for quasiconcave solutions of fully nonlinear partial differential equations*. Indiana University Mathematics Journal, Vol. 60, (2011) 101-120.

- (16) P. Guan and X. Zhang, *A Geodesic equation in the space of Sasakian metrics*, Geometry and Analysis I (2011), pp. 303-318. Ed. Lizhen Ji, Advanced Lectures in Mathematics, International Press.
- (17) P. Guan, *Remarks on the homogeneous complex Monge-Ampère equation*, Complex Analysis, Trends in Mathematics, Springer Basel AG. (2010), 175-185.
- (18) B. Bian and P. Guan, *A structural condition for microscopic convexity principle*, Discrete and continuous dynamical systems Volume 28, (2010) 789-807.
- (19) P. Guan, Q. Li and X. Zhang, *A uniqueness theorem in Kähler geometry*, Math. Ann. Vol. 345, (2009) 377-393.
- (20) P. Guan and J. Li, *The quermassintegral inequalities for  $k$ -convex starshaped domains*, Advances in Mathematics 221 (2009) 1725-1732.
- (21) B. Bian and P. Guan, *A Microscopic Convexity Principle for Nonlinear Partial Differential Equations*, Inventiones Mathematicae, V. 177, (2009), 307-335.
- (22) P. Guan, C.S. Lin and X. Ma, *The Existence of Convex Body with Prescribed Curvature Measures* International Mathematics Research Notices, Vol. 2009, (2009) 1947-1975.
- (23) P. Guan and E. Sawyer, *Regularity of Subelliptic Monge-Ampère Equations in the Plane*, Transactions of American Mathematical Society, Vol. 361, No. 9, (2009), 4581-4591.
- (24) P. Guan, X. Ma, N. Trudinger and X. Zhu, *A form of Alexandrov-Fenchel inequality*, Pure and Applied Mathematics Quarterly, V. 6, (2010), 999-1012.
- (25) B. Bian and P. Guan, *Convexity Preserving for Fully Nonlinear Parabolic Integro-Differential Equations*, Methods and Applications of Analysis, Vol. 15 (2008), 39-51.
- (26) L. Caffarelli, P. Guan and X. Ma, *A constant rank theorem for solutions of fully nonlinear elliptic equations*, Communications on Pure and Applied Mathematics. V. 60, (2007), 1769-1791.
- (27) P. Guan, C.S. Lin and G. Wang, *Local gradient estimates for quotient equations in conformal geometry* International Journal of Mathematics, Vol. 18, No. 4 (2007) 349-361 .
- (28) P. Guan and G. Wang, *Conformal deformations of the smallest eigenvalue of the Ricci tensor*, American Journal of Mathematics, Vol. 129, (2007), 499-526.
- (29) P. Guan, X. Ma and F. Zhou, *The Christoffel-Minkowski problem III: existence and convexity of admissible solutions*, Communications on Pure and Applied Mathematics, V.59, (2006) 1352-1376.

- (30) P. Guan, C.S. Lin and X. Ma, *The Christoffel-Minkowski problem II: Weingarten curvature equations*, Chinese Annals of Mathematics, Series B. Vol. 27B(6), (2006), 595-614.
- (31) P. Guan, C.S. Lin and G. Wang, *Schouten tensor and some topological properties*, Communications in Analysis and Geometry, V.13, No. 5, 2005, pp. 887-902.
- (32) P. Guan and G. Wang, *Geometric inequalities on locally conformally flat manifolds*, Duke Math. Journal, V.124, (2004), 177-212.
- (33) P. Guan and X. Ma, *Convex solutions of elliptic differential equations in classical differential geometry*, "Geometric Evolution Equations", Workshop on Geometric Evolution Equations, Edited by S. Chang, B. Chow, S. Chu and C.S. Lin, Contemp Math. V.367, AMS. pp. 115-128.
- (34) P. Guan, C.S. Lin and G. Wang, *Application of The Method of Moving Planes to Conformally Invariant Equations*, Mathematische Zeitschrift, V. 247 (2004), pp. 1-19.
- (35) P. Guan and X. Ma, *Christoffel-Minkowski problem I: convexity of solutions of a Hessian equation*, Inventiones Mathematicae, V.151 (2003), 553-577.
- (36) P. Guan and G. Wang, *Local estimates for a class of fully nonlinear equations arising from conformal geometry*, International Mathematics Research Notices, V. 2003, Issue 26(2003), 1413-1432.
- (37) P. Guan, *Nonlinear Degenerate Elliptic Equations*, Proc. of ICCM2001, Taiwan, 2001. Edited by C.S. Lin, L. Yang and S.T. Yau, International Press, (2004), 257-266.
- (38) P. Guan and G. Wang, *A fully nonlinear conformal flow on locally conformally flat manifolds*, Journal fur die reine und angewandte Mathematik, V. 557 (2003), 219-238.
- (39) P. Guan, J. Viaclovsky, G. Wang, , *Some properties of the Schouten tensor and applications to conformal geometry*, Transactions of American Math. Society, V.355 (2003), 925-933.
- (40) P. Guan, *Extremal Function associated to Intrinsic Norms*, Annals of Mathematics, 156(2002), 197-211.
- (41) B. Guan and P. Guan, *Convex Hypersurfaces of Prescribed Curvature*, Annals of Mathematics, 156(2002), 655-674.
- (42) P. Guan, N. Trudinger and X. J. Wang, *Boundary regularity for degenerate Monge-Ampere equations*, Acta Math. 182, (1999), 87-104.
- (43) P. Guan and X. Wang, *On a Monge-Ampere Equations Arising in Geometric Optics*, Journal of Diff. Geometry, 48, (1998), 205-222.
- (44) P. Guan and E. Sawyer, *Oblique Derivative Problem*, CRM Proc. and Lecture Notes, Vol.12 (1997), 145-158.

- (45) P. Guan,  *$C^2$  A Priori Estimates for Degenerate Monge-Ampere Equations*, Duke Math. Journal, 86, (1997), 323-346.
- (46) P. Guan, *Quasilinear Degenerate Elliptic Equations in Divergence Form*, Contemporary Math., AMS, 205, (1997), 93-100.
- (47) P. Guan and Y. Li,  *$C^{1,1}$  Regularity for Solutions of a Problem of Alexandrov*, Comm. Pure and Appl. Math., 50, (1997), 789-811.
- (48) P. Guan, *Regularity of a Class of Quasilinear Degenerate Elliptic Equations*, Advances in Mathematics, Vol. 132(1997), 24-45.
- (49) P. Guan and E. Sawyer, *Regularity Estimates for Oblique Derivative Problem on Nonsmooth Domains (II)*, Chinese Ann. Math., Ser. B, 17, (1996), 1-36.
- (50) P. Guan and E. Sawyer, *Regularity Estimates for Oblique Derivative Problem on Nonsmooth Domains (I)*, Chinese Ann. Math., Ser. B, 16, (1995), 299-324.
- (51) P. Guan and Y. Li, *On Weyl Problem With Nonnegative Gauss Curvature*, Journal of Differential Geometry, 39 (1994), 331-342.
- (52) P. Guan and E. Sawyer, *Regularity Estimates of Oblique Derivative Problem*, Annals of Mathematics, 137, (1993), 1-70.
- (53) P. Guan, *On An Example of Subelliptic Boundary Value Problem*, Proc Symposia in Pure Math.,AMS, 52 (1991), 173-177.
- (54) P. Guan, *Holder Regularity of Subelliptic Pseudo-differential Operators*, Duke Math. Journal, 60 (1990), 563-598.

#### Lecture Notes:

- (1) P. Guan, *Monge-Ampère Equations and Related Topics*, Morningside Institute, Academic Sinica, Beijing, China, 1998.
- (2) P. Guan, *Topics Geometric fully nonlinear equations*, lecture notes, 170-page manuscript (2004).
- (3) P. Guan, *Curvature measures, isoperimetric type inequalities and fully nonlinear PDEs*, "Fully Nonlinear PDEs in Real and Complex Geometry and Optics", Springer Lecture notes in Mathematics 2087, CIME, Italy, July (2012).
- (4) P. Guan, *Monge-Ampère Type Equations and Related Geometric Problems*, Lecture notes at Mini-School of Nonlinear Equations, Harvard University, December 3-4, 2016.

#### Invited Talks :

- (1) *Some fully nonlinear equations related to curvature measures*, Conference on Geometric and Nonlinear Analysis: Meeting in Lorraine, June 12, 2011.

- (2) *Geometric Quantities Associated to the Normalized Gauss Curvature Flow*, A Conference in Honor of the 60th Birthday of Chang-Shou Lin, July 9, 2011, Taiwan University.
- (3) *Maximum rank property and partial Legendre transform of homegenous Monge-Ampere type equations*, Conference in Harmonic Analysis and Partial Differential Equations, Fields Institute, University of Toronto, July 28, 2011.
- (4)  *$C^2$  estimates for a class of fully nonlinear geometric PDEs*, workshop on "Recent trends in Geometric and Nonlinear Analysis" August 7, 2012, Banff International Research Station, Canada
- (5) *Soliton and uniform convergence of the normalized Gauss Curvature flow*, Nov. 7, 2012, Conference on Geometric PDEs, Henri Poincare Institute, France
- (6) *On a uniqueness problem in classical geometry and the maximum principle*, seminar talk, Courant Institute, NYU, March 9, 2012.
- (7) *Fully nonlinear equations in geometry*, five lectures, CIME Summer School on "Fully Nonlinear PDEs in Real and Complex Geometry and Optics", Cetraro, Italy, July 9-13, 2012.
- (8) *A new mean curvature type flow and geometric applications*, colloquium talk, Central Florida University, Oct. 9, 2012.
- (9) *A convexity Principle and geometric application*, colloquium talk, Oct. 10, 2012, University of Florida.
- (10) *A generalized mean curvature flow for starshaped domains in space forms*, seminar talk, Columbia University, Dec. 6, 2012.
- (11) *Three Problems in nonlinear Geometric PDE*, International conference on Elliptic and Geometric PDEs, December 24, 2012, Huangshan, China.
- (12) *Isoperimetric-type inequalities and flows of hypersurfaces in spaces of constant curvatures*, Colloquium talk, Department of Mathematics, Stanford University, May 3, 2013.
- (13) *New curvature estimates for Weingarten equations*, lecture in "Conference on Analysis, Complex Geometry, and Mathematical Physics", Columbia University, May 10, 2013.
- (14) *Two uniqueness Theorems in geometry, old and new*, lecture in "Conference on Analysis and Partial Differential Equations", PIMS, UBC, July 9, 2013.
- (15) *A mean curvature type flow and isoperimetric inequality in warped product space*, Workshop in Partial Differential Equations, Oberwolfach, Germany, August 5, 2013.
- (16) *Regularity estimates for Curvature equations*, Fields Geometric Analysis Colloquium, Fields Institute, Toronto, November 15, 2013.

- (17) *Parabolic curvature equations and geometric applications*, Conference in Non-linear Partial Differential Equations, Tongji University, Shanghai, China, December 21, 2013.
- (18) *Curvature estimates for immersed submanifolds in Space form*, Geometric Analysis Seminar, Princeton University, April 15, 2014.
- (19) *Geometric flows and isoperimetric type inequalities*, Geometry and Analysis Seminar, Dieudonn Laboratory, Universite de Nice, Nice, France, June 12, 2014.
- (20) *New mean curvature estimates for immersed hypersurfaces*, CONFERENCE OF CALCULUS OF VARIATIONS: Geometry, Inequalities, and Design, Fields Institute, November 14, 2014.
- (21) *Nonlinear Parabolic Equations and Isoperimetric Type Inequalities*, Colloquium, Ohio State University, April 23, 2015.
- (22) *Isometric embeddings of  $(S^2, g)$  to general warped product space  $(N^3, \bar{g})$* , seminar in Geometric Analysis, Center of Mathematical Sciences and applications, Harvard University, October 13, 2015.
- (23) *The Weyl isometric embedding problem in general 3-d Riemannian manifolds*, Harvard University, Conference on Nonlinear Equations, April 8, 2016.
- (24)  *$C^2$  estimate for solutions to scalar curvature type equations on Riemannian manifolds*, Complex Geometry and PDE Seminar, Columbia University, May 19, 2016.
- (25) *Isometric embedding problems, geometric inequalities and nonlinear PDEs*, Workshop of Geometric Analysis in Samothrace, Greece, June 1, 2016.
- (26) *Regularity of immersed hypersurfaces in Riemannian manifolds*, The 2016 Xiamen International Conference on Partial Differential Equations and Applications, Xiamen, China, June 15, 2016.
- (27) *Nonlinear PDEs and isoperimetric type inequalities*, seminar, UESTC, Chengdu, China, June 20, 2016.
- (28) *Regularity and convergence of the Gauss curvature type flows*, Northwestern University of China, Xi'an, June 22, 2016.
- (29) *The Weyl's Isometric Embedding Problem in General Riemannian Manifolds*, seminar, Xi'an Jiaotong University, June 24, 2016.
- (30) *Curvature flows and the isoperimetric problems in geometry*, Joint Diff. Geom, Math. Phys. & PDE Seminar, UBC, Oct. 25, 2016.
- (31) *Monge-Ampère Type Equations and Related Geometric Problems*, Lectures at Mini-School of Nonlinear Equations, Harvard University, December 3-4, 2016.
- (32) *The Weyl isometric embedding problem to general 3D Riemannian manifolds*, Geometric Analysis Colloquium at Fields, University of Toronto, March 3, 2017.

- (33) *Isometric Embeddings, Geometric Inequalities and Nonlinear PDEs*, Colloquium, University of Miami, April 12, 2017.
- (34) *The isoperimetric problem in general manifolds and a mean curvature type flow*, Colloquium, Florida Central University, April 14, 2017.
- (35) Intermediate  $L^p$ -Christoffel-Minkowski problem, seminar, Columbia University, April 20, 2017.
- (36) *Regularity estimates for scalar curvature equations.*, Baltimore-Washington Metro Area Differential Geometry Seminar, April 22, 2017.

### Supervision of the graduate students since 2011:

*M.S.:*

Sebastien Picard (2011-2013, Ph.D. student at Columbia University now), A priori estimates of the degenerate Monge-Ampère equation on compact Kähler manifolds

Sung Chul Park (2013-2014, Ph. D. student at University of Berkeley now). an interior estimate for a class of Weingarten curvature equations

*Ph.D.:*

Xiangwen Zhang (2012, CMS Ph.D. thesis prize, went to Columbia University as Rita assistant professor 2012-2015, tenure-track assistant professor at UC Irvine 2015-

) , Complex Monge-Ampère Equation and its Applications in Complex Geometry

Siyuan Lu (2016, Hill assistant professor at Rutgers University), On a class of fully nonlinear equations and their applications in geometry

Shaodong Wang (current, co-supervisor).

*Ph.D. graduate trainee:*

Guohuan Qiu (2015-2016, now CRC postdoctoral fellow at McGill University, 2016-2018). Neumann problem for  $\sigma_k$ -equations.

### Supervisorships of postdoctoral fellows since 2011:

Hongnian Huang (8-2009 to 8-2011, co-supervisor, tenure track assistant professor at University of New Mexico), The Calabi flow and complex Monge-Ampère equations

Zhizhang Wang (1-2010 to 7-2011, now associate professor at Fudan University), Global  $C^2$  estimates for convex solutions of curvature equations,

Renjie Feng (8-2012 to 8-2013, co-supervisor, assistant professor at Beijing University), Topics in geometric analysis

Yiyan Xu (7-2013 to 8-2014, tenure-track assistant professor at Nanjing University), Shrinking Ricci solitons.

Chao Xia (1-2015 to 7-2016, associate professor at Ximen University, awarded Thousand Young Talents in China),  $L^p$  Christoffel-Minkowski problem

Rohit Jain (8-2016 to current, co-supervisor), Regularity of the obstacle problems

Guohuan Qiu (8-2016 to current). interior estimates for convex solutions of scalar curvature equation.



**Research collaborators since 2011:**

- Changyu Ren (11-2010 to 11-2011), Global  $C^2$  estimates for curvature equations  
 Chuanhe Li (8-2014 to 8-2015), Infinitesimal rigidity of the Weyl's problem in general Riemannian manifolds  
 Zhizhang Wang (7-2014 to 7-2015), Infinitesimal rigidity of the Weyl's problem in general Riemannian manifolds  
 Junfang Li (August-Dec., 2016). An integral formula and its applications

**Supervision of undergraduate students summer research since 2011:**

- Yang Guo (2011, Ph. D. student at dept of math., London School of Economics and Political Science), The Minkowski problem  
 Xixi Shen (2012-2013, Ph.D. student Dept of math., Northwestern University), Rigidity of immersed hypersurfaces  
 Xuesi Cai (2013-2014, work in an actuary in Toronto ), Positivity of mean curvature of hypersurfaces with nonnegative scalar curvature  
 Zhiguo Zhang (2015, Ph.D. student dept of Computer Science, McGill University), Curve shorting flows.  
 Dylan Cant (2015-2016, to be a Ph.D. student dept of math., Stanford University in 2017). A Curvature Flow and Applications to an Isoperimetric Inequality.

**Administrative Responsibilities***internal*

- Council of Graduate and Postdoctoral Studies, McGill University, 2015-  
 Departmental Undergraduate Affair Committee (2014-)  
 Departmental Hiring committee for analysis position (2014-2015)  
 Departmental Graduate Affair Committee (2011-2014)  
 Departmental director of Graduate Studies (2008-2011)

*external*

- NSF Review Panels (2005, 2008, 2014, 2015)  
 NSERC grant selection committee (CGA337, 2006-2007, 2014-2017)  
 Vice President of Canadian Mathematical Society, (2009-2011)  
 Scientific Advisory Committee of Fields Institute (2010-2014).

**Editorship:**

- Associate editor (2004-2009), Canadian Journal of Mathematics,  
 Associate editor (2004-2009), Bulletin of Canadian Mathematical Society.  
 Associate editor (2013-2015), Annales mathématiques du Québec.

**Organization of conferences and workshops:**

- Geometric properties of solutions of nonlinear PDEs and their applications.* BIRS workshop, July 17-22, 2011.

*International conference on Elliptic and Geometric PDEs*, December, 2012, Huangshan, China.

*Nice meeting of Geometric Analysis in honor of Philippe Delanoë*, June 2-4, 2014, Nice, France.

*Nirenberg Lecture Series in Geometric Analysis*, CRM, 2014–

*BIRS workshop on geometric and analytic inequalities*, July 10-15, 2016.

*Geometric Analysis, Mathematical Congress of Americans*, session organizer, July 2017.