

Wing Hong Felix KWOK

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AFFILIATION

Section de mathématiques, Université de Genève

RESEARCH INTERESTS

- General* Numerical methods for linear and nonlinear PDEs, parallel computing and large-scale simulations with applications in engineering and physics, reservoir simulation and modeling.
- Specific Interests* Efficient solution of large nonlinear systems arising from the discretization of PDEs. Applications in reservoir simulation, computational fluid dynamics and structural mechanics. Iterative methods for solving the associated sparse linear systems. Parallel computing and domain decomposition for time-dependent problems: optimized Schwarz methods, FETI methods, waveform relaxation methods, algebraic formulations. Preconditioning techniques and multiscale methods.

RESEARCH EXPERIENCE

- 2011 – present Collaborateur scientifique II, Section de mathématiques
Université de Genève, Geneva, Switzerland
Tenured research/lecturer position. Teaching and research in numerical analysis and scientific computing, with emphasis on domain decomposition methods.
- 2010 – 2011 Maître-assistant, Section de mathématiques
Université de Genève, Geneva, Switzerland
Postdoctoral position, with teaching. Research in numerical analysis and scientific computing, with emphasis in domain decomposition methods.
- 2008 – 2010 Postdoctoral Research Assistant, Section de mathématiques
Université de Genève, Geneva, Switzerland
Research in domain decomposition methods, under the supervision of Prof. Martin J. Gander.
- Summer 2004 & Summer 2005 Research Intern, Department of Mathematical Sciences
IBM T.J. Watson Research Center, Yorktown Heights, NY
Development of general-purpose iterative linear solvers for the Watson Sparse Matrix Package under the supervision of Dr. Anshul Gupta. Installation and testing of HPC packages under the AIX environment.

EDUCATION

- 2002 – 2007 **Ph.D., Scientific Computing/Computational Mathematics**
Stanford University
Dissertation: “Scalable Linear and Nonlinear Algorithms for Multi-phase Flow in Porous Media”
Advisor: Prof. Hamdi Tchelepi
Relevant Courses: Reservoir Simulation, Gas Injection Processes, Applied PDEs (full-year), Numerical PDEs (full-year), Finite Element Analysis (full-year), Parallel Methods in Numerical Analysis, Numerical Linear Algebra, Eigenvalue Computation.
- 2000 – 2002 **B.Sc., Joint Honors in Mathematics and Computer Science**
McGill University
First Class Honors, Dean’s Honor List
- 1998 – 2002 **B.Eng., Computer Engineering**
McGill University
Great Distinction, Dean’s Honor List

GRANTS, AWARDS AND HONORS

- 2012 Funding for Conference “Domain decomposition methods for optimization with PDE constraints” (co-applicant with M. J. Gander and R. Krause, CHF 27 000)
Centro Stefano Franscini & Swiss National Science Foundation
- 2010 NSERC Postdoctoral Fellowship (awarded CA \$40 000/year, declined)
Government of Canada
- 2004 – 2007 NSERC Postgraduate Scholarship (Doctoral, CA \$21 000/year)
Government of Canada
- 2002 – 2004 FCAR Masters Research Scholarship (CA \$15 000/year)
Government of Quebec (Canada)
- 2002 SIAM 100-Dollar, 100-Digit Challenge (US \$100)
First prize winner, with M. J. Gander, S. Loisel, N. Nigam and P. Tupper
- 2002 Canada Governor General’s Silver Medal
Awarded to the undergraduate who achieved the highest academic standing upon graduation from a bachelor degree program (two per year at McGill)
- 2002 Charles Michael Morssen Gold Medal for Exceptional Engineering Promise
Faculty of Engineering, McGill University
- 2002 Edward Rosenthal Memorial Prize (CA \$750)
Department of Mathematics, McGill University

TEACHING EXPERIENCE

Autumn 2013	Algèbre I, Université de Genève 1st year course on Linear Algebra, Enrollment: 100 (approx.)
Autumn 2010– Winter 2013	Analyse numérique, Université de Genève Full year course for 2nd year undergraduates, Enrollment: 40 (approx.)
Autumn 2012	Analyse numérique des équations aux dérivées partielles, Université de Genève Advanced undergraduate/masters course on numerical methods for PDEs, Enrollment: 12
June 2012	Reservoir simulation, ENI Corporate University, Italy Training course for reservoir engineers on the theory and numerics of reservoir simulators, Enrollment: 14
Winter 2010	Mathématiques pour informaticiens, Université de Genève 1st year course for Computer Science students, Enrollment: 20 (approx.)
Winter 2008– Autumn 2010	Analyse numérique, Université de Genève <i>Teaching Assistant</i> (Instructors: Prof. M. J. Gander/Dr. S. Loisel) 2nd year undergraduate course, Enrollment: 40 (approx.)
Winter 2004	CS137 Introduction to Scientific Computing, Stanford University <i>Teaching Assistant</i> (Instructor: Prof. G. H. Golub) 1st year graduate course, Enrollment: 30 (approx.)
Autumn 2003	CS237A Numerical Linear Algebra, Stanford University <i>Teaching Assistant</i> (Instructor: Prof. G. H. Golub) 1st year graduate course, Enrollment: 40 (approx.)

STUDENT SUPERVISION

2011 – present	Bankim C. Mandal (Ph.D. student, joint supervision with M. J. Gander) <i>Université de Genève, Geneva, Switzerland</i> Space-time domain decomposition for time-dependent PDEs.
2011 – 2013	Pablo Strasser (M.S. student, joint supervision with M. J. Gander) <i>Université de Genève, Geneva, Switzerland</i> Numerical methods for for simulating two-phase flow with evolving boundaries, such as fountains.

UNIVERSITY SERVICE

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| 2011 – present | Computing service coordinator for the Mathematics Department,
University of Geneva
<i>Ordering of new equipment, budget management, local technical support,
liaison with the university computing division</i> |
| 2011 – present | Webmaster for ddm.org , official page of Domain Decomposition Methods |
| 2006 | Student consultant for C^2 Project, ICME, Stanford University |
| 2003 – 2006 | Student officer, SIAM Stanford Student Chapter |

CONFERENCE ORGANIZATION

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| September 2013 | 22nd International Conference on Domain Decomposition Methods
<i>Lugano, Switzerland</i>
Minisymposium co-organizer (Achieving scalability in domain decomposition methods: advances in coarse spaces and alternatives, with K. Santugini) |
| September 2013 | Domain Decomposition Methods for Optimization with PDE Constraints
<i>Ascona, Switzerland</i>
Conference co-organizer, with M. J. Gander and R. Krause |
| June 2012 | 21st International Conference on Domain Decomposition Methods
<i>Rennes, France</i>
Minisymposium co-organizer (Space-time parallel methods, with M. J. Gander and Y. Maday) |
| February 2011 | 20th International Conference on Domain Decomposition Methods
<i>San Diego, CA</i>
Minisymposium co-organizer (Domain decomposition and massive parallelism, with S. Loisel) |
| June 2008 | Conference on Scientific Computing, in honor of E. Hairer's 60th birthday
<i>Geneva, Switzerland</i>
Local organizing team |

PROFESSIONAL SOCIETIES

- Society for Industrial and Applied Mathematics
Canadian Applied and Industrial Mathematics Society

PERSONAL INFORMATION

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| <i>Citizenship</i> | Canadian |
| <i>Languages</i> | English, French, Chinese |

REFERENCES

- Available upon request.

List of Publications for FELIX KWOK

PUBLICATIONS

Refereed Journal Publications

1. MARTIN J. GANDER, FELIX KWOK AND BANKIM C. MANDAL, *Dirichlet–Neumann and Neumann–Neumann waveform relaxation methods for the time-dependent heat equation*, submitted.
2. FELIX KWOK, *Accuracy and stability of a predictor-corrector Crank-Nicolson method with many subdomains*, submitted.
3. MARTIN J. GANDER and FELIX KWOK, *Best Robin parameters for optimized Schwarz methods at cross points*, SIAM J. Sci. Comput., 34 (2012), pp. A1849–A1879.
4. MARTIN J. GANDER and FELIX KWOK, *Chladni figures and the Tacoma bridge: motivating PDE eigenvalue problems via vibrating plates*, SIAM Rev., 54 (2012), pp. 573–596.
5. FELIX KWOK, *Optimized additive Schwarz with Harmonic Extension as a discretization of continuous parallel Schwarz methods*, SIAM J. Numer. Anal., 49 (2011), pp. 1289–1316.
6. FELIX KWOK and HAMDI TCHELEPI, *Convergence of implicit monotone schemes with applications in multiphase flow in porous media*, SIAM J. Numer. Anal., 46 (2008), pp. 2662–2687.
7. FELIX KWOK and HAMDI TCHELEPI, *Potential-based reduced Newton algorithm for nonlinear multiphase flow in porous media*, J. Comput. Phys., 227 (2007), pp. 706–727.

Refereed Conference Proceedings

8. FELIX KWOK, *Neumann–Neumann waveform relaxation for the time-dependent heat equation*, to appear in the Proceedings of the 21st International Conference on Domain Decomposition Methods, Rennes, France, June 2012.
9. FELIX KWOK, *A parallel Crank–Nicolson predictor-corrector method for many subdomains*, to appear in the Proceedings of the 21st International Conference on Domain Decomposition Methods, Rennes, France, June 2012.
10. MARTIN J. GANDER and FELIX KWOK, *On the applicability of Lions’ energy estimates in the analysis of discrete optimized Schwarz methods with cross points*, In Domain Decomposition in Science and Engineering XX, Lecture Notes in Computational Science and Engineering 91, pp. 475–483, Springer–Verlag, 2013.
11. FELIX KWOK, *Is Additive Schwarz with Harmonic Extension just Lions’ method in disguise?* In Domain Decomposition in Science and Engineering XIX, Lecture Notes in Computational Science and Engineering 78, pp. 439–446, Springer–Verlag, 2010.
12. MARTIN J. GANDER and FELIX KWOK, *Optimal interface conditions for an arbitrary decomposition into subdomains*. In Domain Decomposition in Science and Engineering XIX, Lecture Notes in Computational Science and Engineering 78, pp. 101–108, Springer–Verlag, 2010.

Miscellaneous

13. MARTIN J. GANDER, WALTER GANDER AND FELIX KWOK, *Scientific Computing: an Introduction Using Maple and Matlab*. (Textbook, in review)
14. PIERRE DE LA HARPE and FELIX KWOK, *Prix Nobel de chimie, quasi-cristaux, périodicité et pavages*, Images des Mathématiques, CNRS, 2011. (Online article for general public)
15. FELIX KWOK, *Scalable Linear and Nonlinear Algorithms for Multiphase Flow in Porous Media*, PhD Thesis, Stanford University, Stanford, CA, Dec. 2007.

Manuscripts in preparation (available upon request)

16. FELIX KWOK AND SEBASTIEN LOISEL, *Coarse grid correction for waveform relaxation methods*. (Research article)
17. MARTIN J. GANDER, FELIX KWOK AND KEVIN SANTUGINI, *Optimized Schwarz methods at cross points: the finite volume case*. (Research article)
18. RONALD D. HAYNES AND FELIX KWOK, *Discrete analysis of domain decomposition approaches for mesh generation via the equidistribution principle*. (Research article)
19. MARTIN J. GANDER, FELIX KWOK AND GERHARD WANNER, *History of Constrained Optimization*. (Proceedings of the OPTPDE Program)

TALKS AT CONFERENCES AND WORKSHOPS

Invited talks

1. “What makes block Jacobi slow, and how low-rank changes can help”, PRECOND 2011, Bordeaux, France, May 2011.
2. “Potential ordering methods for nonlinear solution of three-phase flow in porous media”, Conference on Challenges of Porous Media, Kaiserslautern, Germany, March 2009.

Minisymposium talks

3. “Coarse grid correction for the Neumann–Neumann waveform relaxation method”, 22nd International Conference on Domain Decomposition Methods, Lugano, Switzerland, September 2013.
4. “Coarse grid correction for the Neumann–Neumann waveform relaxation method”, SIAM Conference on Computational Science & Engineering, Boston, MA, February 2013.
5. “Multiscale finite element and finite volume methods”, Algoritmy 2012, Podbanske, Slovakia, September 2012.
6. “Neumann–Neumann waveform relaxation methods for the time-dependent heat equation”, 21st International Conference on Domain Decomposition Methods, Rennes, France, June 2012.
7. “Accuracy and stability of a predictor-corrector Crank-Nicolson method with many subdomains”, International Conference on Scientific Computation and Differential Equations (SciCADE), Toronto, Canada, July 2011.

8. “Optimized Schwarz methods for problems with cross points.” MS19 (Schwarz Methods: Analysis and Applications), 20th International Conference on Domain Decomposition Methods, San Diego, California, USA, February 2011.
9. “Algebraic vs. continuous formulations of domain decomposition methods.” MS-DD (Parallelizing your differential equation solver: a tutorial introduction to domain decomposition methods), 31st Annual Meeting of the Canadian Applied and Industrial Mathematics Society, St. John’s, NL, July 2010.
10. “Optimal interface conditions for an arbitrary decomposition into subdomains.” MS1 (Continuous and Discrete Optimized Schwarz Methods), 19th International Conference on Domain Decomposition Methods, Zhangjiajie, China, August 2009.
11. “Ordering-based approaches for improving solver efficiency in reservoir simulation.” MS18 (Computational Methods for Transport in Porous Media), SIAM Annual Meeting, San Diego, CA, July 2008.
12. “Multistage preconditioning for coupled unstructured reservoir models and multisegment wells.” MS111 (Iterative Solvers for Subsurface Simulations), SIAM Annual Meeting, San Diego, CA, July 2008.
13. “Combining direct and iterative methods to solve partitioned linear systems.” MS 29 (Hybrid Direct/Iterative Techniques for the Solution of Large Linear Systems), SIAM Conference on Parallel Processing, San Francisco, CA, February 2004.

Contributed talks

14. “Neumann–Neumann waveform relaxation methods for the time-dependent heat equation”, Conference in honor of the 70th Birthday of Nancy Nichols, Reading, UK, July 2012.
15. “Accuracy and stability of a predictor-corrector Crank-Nicolson method with many subdomains”, 21st International Conference on Domain Decomposition Methods, Rennes, France, June 2012.
16. “Chladni Figures and the Tacoma Bridge: Motivating PDE Eigenvalue Problems via Vibrating Plates”, Swiss Numerics Colloquium, Lugano, Switzerland, May 2011.
17. “Potential ordering methods for nonlinear solution of three-phase flow in porous media”, International Conference on Nonlinearities and Upscaling in Porous Media, Stuttgart, Germany, October 2009.
18. “Is the additive Schwarz method with Harmonic Extension just Parallel Schwarz in disguise?” 19th International Conference on Domain Decomposition Methods, Zhangjiajie, China, August 2009.
19. “An algebraic optimized Schwarz method that converges in finitely many steps.” Schweizer Numerik Kolloquium, Basel, Switzerland, April 2009.
20. “An algebraic optimized Schwarz method that converges in finitely many steps.” OPTPDE 2008, Warsaw, Poland, December 2008.
21. “Potential-based reduced Newton method for nonlinear multiphase flow in porous media.” American Physical Society Annual March Meeting, Denver, CO, March 2007.

22. “Combining direct and iterative methods to solve partitioned linear systems.” Workshop on Model Reduction Problems and Matrix Methods, PIMS, Banff, Alta., April 2004.

Conference Posters

23. “A Dirichlet–Neumann waveform relaxation method for many subdomains”, 22nd International Conference on Domain Decomposition Methods, Lugano, Switzerland, September 2013. (with Bankim C. Mandal)
24. “Discrete convergence analysis for optimized Schwarz methods using energy estimates”, 22nd International Conference on Domain Decomposition Methods, Lugano, Switzerland, September 2013. (with Martin J. Gander and Kévin Santugini)
25. “A domain decomposition method that converges in two iterations for any subdomain decomposition and PDE”, 22nd International Conference on Domain Decomposition Methods, Lugano, Switzerland, September 2013. (with Martin J. Gander)
26. “Analysis of a predictor-corrector Crank–Nicolson method”, Swiss Numerics Colloquium, Universität Bern, April 2012.
27. “A domain decomposition method that converges in two iterations for any subdomain decomposition and PDE”, High Performance Computing and Emerging Architectures, IMA, University of Minnesota, January 2011. (with Martin J. Gander)
28. “Optimized Schwarz method for problems with cross points”, Schweizer Numerik Kolloquium, ETH Zürich, April 2010.
29. “Ordering-based approaches for improving solver efficiency in reservoir simulation”, Colloque Numérique Suisse, Université de Fribourg, April 2008.
30. “Combining direct and iterative methods to solve partitioned linear systems”, Bay Area Scientific Computing Day, University of San Francisco, March 2005.

TALKS AT UNIVERSITIES AND RESEARCH INSTITUTIONS

31. Séminaire EDP et Analyse Numérique, Laboratoire J.A. Dieudonné, Université Nice Sophia–Antipolis, October 2013.
32. Summer Oil Lecture Series, Memorial University of Newfoundland, August 2012.
33. Mathematical Colloquium, Universität Bern, April 2011.
34. Numerical Analysis Seminar, École Polytechnique Fédérale de Lausanne, September 2010.
35. Séminaire d’analyse appliquée, Université Paris XIII, April 2010.
36. CRM/McGill Applied Mathematics Seminar, McGill University, January 2010.
37. Seminar on Numerical Methods, Laboratoire J.-L. Lions, Université Paris VI, June 2009.
38. Séminaire EDP et Analyse Numérique, Laboratoire J. A. Dieudonné, Université Nice Sophia–Antipolis, December 2008.
39. Séminaire d’analyse appliquée, Université Paris XIII, November 2008.

40. Séminaire d'analyse numérique, Université de Genève, October 2008.
41. Seminar für Analysis und Numerik, Universität Basel, September 2008.
42. Séminaire d'analyse numérique, Université de Genève, February 2008.
43. CRM/McGill Applied Mathematics Seminar, McGill University, January 2008.
44. Department of Mathematical Sciences, IBM T.J. Watson Research Center, Yorktown Heights, NY, January 2008.
45. 24th SUPRI-B Reservoir Simulation Industrial Affiliates Meeting, Stanford University, May 2007.
46. 23rd SUPRI-B Reservoir Simulation Industrial Affiliates Meeting, Stanford University, May 2006.
47. 22nd SUPRI-B Reservoir Simulation Industrial Affiliates Meeting, Stanford University, May 2005.
48. Department of Mathematical Sciences, IBM T.J. Watson Research Center, Yorktown Heights, NY, September 2005.
49. Scientific Computing/Computational Math Seminar, Stanford University, April 2004.