

Name: Xing Cai
 Born: 06.04.1968
 Nationality: Norwegian
 Present position: Head of Department, Professor of Scientific Computing

Academic degrees

1998 Dr. Scient (PhD) in Scientific Computing, Department of Informatics, University of Oslo
 1994 Cand. Scient (MSc) in Mathematical Modeling, Department of Informatics, University of Oslo

Work experience

2014–present Head of High Performance Computing Department, Simula Research Laboratory, Norway
 2008–present Professor, Dept. of Informatics, Univ. of Oslo, Norway
 2001–2014 Research Scientist, Simula Research Laboratory, Norway
 1999–2008 Associate Professor, Dept. of Informatics, Univ. of Oslo, Norway
 1998–1999 PostDoc, Dept. of Informatics, Univ. of Oslo, Norway
 1995–1998 PhD Candidate, Dept. of Informatics, Univ. of Oslo, Norway
 1994–1995 Research Scientist, SINTEF, Norway

Supervision of graduate students and postdoctoral fellows

2001 - 2015 Number of PostDocs: 3, PhD students (graduated): 5, visiting PhD students: 5, Master Students (graduated): 17, on various subjects of parallel programming, high-performance computing, visualization and numerical methods. Department of Informatics, University of Oslo and Simula Research Laboratory, Norway

Teaching activities

1999 - 2015 Regular university courses about programming, scientific computing and numerical methods at both bachelor and master levels - Department of Informatics, University of Oslo, Norway
 2006.08 CMA Summer School on Computational Quantum Mechanics, University of Oslo, Norway
 2001.03 Geilo Winter School in Computational Mathematics, Geilo, Norway

Professional activities

- Faculty member, Department of Informatics, University of Oslo, Norway
- Visiting scholar, University of California, San Diego, USA (2010.8-2011.2), University of Stuttgart, Germany (2006.10 & 2007.3)
- Editorial Board, International Journal of Web Science, Inderscience, 2011 - present
 Frontiers in Computational Physics (a specialty of Frontiers in Physics), Frontiers Media, 2013 - present
- Guest co-editor for IJCSE special issue on High Performance Parallel and Grid Computing for Science and Engineering, Volume 4, Issue 2, 2009
- Guest associate co-editor for IEICE special issue on Parallel/Distributed Computing and Networking, February issue, 2006
- Research proposal evaluator, National Research Foundation of South Africa, 2006
 DOE SciDAC mid-term review, USA, 2009
 DOE Office of Science Graduate Fellowship Program, USA, 2010
 The Netherlands Organisation for Scientific Research, Innovational Research Incentives Scheme, 2010
- PhD opponent (or evaluation committee member), Uppsala University, Sweden, 2006, 2013, 2014
 Norwegian University of Science and Technology, Norway, 2012
 University of California, San Diego, USA, 2012
 Technical University of Denmark, 2013
 TU Delft, the Netherlands, 2014
 National University of Defense Technology, China, 2014, 2015
- Book reviewer for Springer Verlag, 2004, 2007
- Administrator of PhD evaluation committees at University of Oslo, Norway, 2003, 2012, 2013, 2014, 2015
- Referee for scientific journals: SIAM J. Scientific Computing, Journal of Computational Physics, Advances in Water Resources, Advances in Engineering Software, Advances in Mathematical Physics, Applicable Algebra in Engineering, Communication and Computing, Applied Mathematical Modelling, IEEE Transactions on Image Processing, Ocean Engineering, Parallel Computing, Future Generation Computer Systems,

The Journal of Supercomputing, Int. J. Computational Science and Engineering, Journal of Computational and Applied Mathematics, Journal of Parallel Algorithms and Applications, Int. J. Innovative Computing and Applications, Nonlinear Analysis: Modelling and Control, Int. J. Manufacturing Technology and Management, Int. J. Water Resources and Environmental Engineering, Computers and Mathematics with Applications, Mathematical Methods in the Applied Sciences, Computers, Journal of Parallel and Distributed Computing, Int. J. Automation & Computing

- Program co-chair, ICPP-HPSEC05 Workshop, ICCS-IHPCES 2013 Workshop, PHSP14 Workshop, ICCS-IHPCES 2015 Workshop
- Organizer/co-organizer of minisymposia: User-friendly Parallel Programming: Methodologies and Tools at SIAM CSE'13, Advanced Computing in Geosciences at PARA'08, Software Tools for Parallel CFD Applications at PARA'06, Fusion of Information for Hydrologic Sciences at the WPGM 2006 Conference
- Program/technical committee member for ISC-16, ICCS-16, VECPAR-16, ISC-15, ICCS-15, ADVCOMP-15, PDSEC-15, ICCS-14, ISC-14, VECPAR-14, ADVCOMP-14, SC-13, ISC-13, PDSEC-13, IHPCES-12, PDSEC-12, VECPAR-12, IHPCES-11, PARENG-11, ISPDC-10, PDSEC-10, IWHGA-10, CSO-10, PDSEC-09, FCST-09, PDSEC-08, PDSEC-07, ICPP-HPSEC06, ICPP-EC06, SC'05, ICPP-EC05, ISPA05, PDSEC-05, HPC-05, ICPP-HPSEC04, PDSEC-04, ECS-04, HPSECA-03

Leadership and management I am Head of the High-Performance Computing Department at Simula Research Laboratory, Norway. Despite the short history of this department (since May 1st, 2014), I have already led the members of the department to 7 published journal papers and 5 published conference proceedings papers. In addition, one PhD thesis and three master-degree theses have been completed.

I am managing a 4-year (2012-2016) FRINATEK project (User-friendly programming of GPU-enhanced clusters via automated code translation and optimization), funded by the Research Council of Norway. In addition, I am coordinating a 3-year (2014-2016) UTFORSK project (Norway-China partnership for supercomputing education and research), jointly funded by Norwegian Centre for International Cooperation in Education and Research Council of Norway. For example, the two projects' total scale of researcher mobility amounts to 97 man-months.

Major collaborations Strategic collaborations have been established with University of California, San Diego (UCSD), USA and National University of Defense Technology (NUDT), China. These two major collaborations gave rise to the two ongoing projects mentioned above. The collaboration with UCSD has greatly expedited Simula's research activities on programming accelerator-enhanced supercomputers, whereas the collaboration with NUDT has provided Simula researchers with access to the world's No. 1 supercomputer: Tianhe-2. The latter resulted in a seminal journal paper that carried out pioneer work on simulations of subcellular calcium dynamics down to nanometer resolution.

10-year track record

Top 10 publications in the last 10 years

- 1 J. Sundnes, G. T. Lines, X. Cai, B. F. Nielsen, K.-A. Mardal, and A. Tveito. Computing the Electrical Activity in the Heart, volume 1 of Monographs in Computational Science and Engineering. Springer-Verlag, 2006.
- 2 J. Chai, J. Hake, N. Wu, M. Wen, X. Cai, G. T. Lines, J. Yang, H. Su, C. Zhang, and X. Liao. Towards simulation of subcellular calcium dynamics at nanometre resolution. *International Journal of High Performance Computing Applications*, 29(1):51–63, 2015.
- 3 J. Langguth, M. Sourouri, G. T. Lines, S. B. Baden, and X. Cai. Scalable heterogeneous CPU-GPU computations for unstructured tetrahedral meshes. *IEEE Micro*, 35(4):6–15, 2015.
- 4 J. Langguth, N. Wu, J. Chai, and X. Cai. Parallel performance modeling of irregular applications in cell-centered finite volume methods over unstructured tetrahedral meshes. *Journal of Parallel and Distributed Computing*, 76:120–131, 2015.
- 5 W. Zhang, W. Wei, and X. Cai. Performance modeling of serial and parallel implementations of the fractional Adams-Bashforth-Moulton method. *Fractional Calculus & Applied Analysis*, 17(3):617–637, 2014.
- 6 M. Wen, H. Su, W. Wei, N. Wu, X. Cai, and C. Zhang. Using 1000+ GPUs and 10000+ CPUs for sedimentary basin simulations. In *Proceedings of IEEE CLUSTER 2012*, pages 27–35. IEEE Computer Society Press, 2012.
- 7 D. Unat, X. Cai, and S. Baden. Mint: Realizing CUDA performance in 3D stencil methods with annotated C. In *Proceedings of the 25th ACM International Conference on Supercomputing (ICS 2011)*, pages 214–224. ACM Press, 2011.
- 8 X. Cai and T.-C. J. Yeh, editors. *Quantitative Information Fusion for Hydrological Sciences*, volume 79 of *Studies in Computational Intelligence*. Springer-Verlag, 2008.
- 9 X. Cai and G. T. Lines. Full-scale simulation of cardiac electrophysiology on parallel computers. In A.M. Bruaset and A. Tveito, editors, *Numerical Solution of Partial Differential Equations on Parallel Computers*, volume 51 of *Lecture Notes in Computational Science and Engineering*, pages 385–411. Springer-Verlag, 2006.
- 10 X. Cai and H. P. Langtangen. Parallelizing PDE solvers using the Python programming language. In A.M. Bruaset and A. Tveito, editors, *Numerical Solution of Partial Differential Equations on Parallel Computers*, volume 51 of *Lecture Notes in Computational Science and Engineering*, pages 295–325. Springer-Verlag, 2006.

The above 10 publications roughly fall under four themes. First, [1], [2] and [9] address cardiac modeling and simulation, for which high-performance computing is a central and enabling technique. In particular, [2] is a seminal journal publication that represents a first-ever attempt at simulating subcellular calcium dynamics down to nanometer resolution. The hardware platform used is Tianhe-2, currently the world’s No. 1 supercomputer. Our numerical experiments used up to 4096 compute nodes on Tianhe-2, amounting to 798,720 CPU and coprocessor cores.

The second theme is about using hardware accelerators in doing large or huge scale scientific computations. While [7], [4] and [3] are generic and application-neutral, [6] and [2] address specific applications in computational geoscience and computational cardiology, respectively. It is believed that [6] and [3] are among the pioneer work that promotes heterogeneous computing, which will likely fit with one of the most important hardware architectures of future.

The third theme is about quantitative performance modeling of parallel implementations of numerical computations. Such modeling, for which [4] and [5] have given some glimpses, is important for identifying potential performance bottlenecks, while also providing suggestions for designing future hardware platforms.

Last but not least, [8] and [10] represent disruptive research efforts made by me. At the time of their writing, both [8] and [10] were ahead of the state of the art. More specifically, [8] proposed the first use of “information fusion” (multi-disciplinary) in hydraulic sciences, whereas [10] investigated the use of then-not-widely used programming language Python in the new context of parallel computing. It is with pleasure to note that both information fusion and parallel Python computing afterwards became widely accepted.

Research Monographs

[1] is a co-authored research monograph.

Research grants

- PI for FRINATEK project User-friendly programming of GPU-enhanced clusters via automated code translation and optimization, Research Council of Norway, 2012-2016
- Coordinator for UTFORSK project Norway-China partnership for supercomputing education and research, Norwegian Centre for International Cooperation in Education & Research Council of Norway, 2014-2016
- co-PI for FRINATEK project PProductivity and Energy-efficiency through Abstraction-based Parallel Programming (PREAPP), Research Council of Norway, 2014-2017
- Institutional PI for Simula's participation in EU Artemis project EMC², 2014-2017
- Coordinator for PFC project Collaborative education of master/PhD-students for future scientific supercomputing, Norwegian Centre for International Cooperation in Education, 2012-2013
- Recipient of BILAT grants, Research Council of Norway, 2006, 2007, 2010, 2012
- Recipient of HPC-Europa grant, EU, 2006

Invited talks to conferences / schools

- Enabling Numerical and Software Technologies for Studying the Electrical Activity in Human Heart, invited keynote talk at PARA 2002 Conference, Finland, June 2002.
- Resource-Efficient Simulation of Tsunami Wave Propagation on Parallel Computers, invited talk at CREST workshop, Japan, December 2008
- A non-invasive approach to parallelizing sequential simulators of partial differential equations, invited guest lecture at UCSD, USA, October 2010
- Parallel simulation of particle transport using OpenMP, invited guest lecture at UCSD, USA, January 2011
- Programming with OpenMP and mixed MPI-OpenMP, invited lecture at pre-conference workshop of NOTUR 2011, Norway, May 2011
- Scientific computing needs supercomputers, but also something else! invited guest lecture at National University of Defense Technology, China, March 2012
- Scientific computing on accelerator-based supercomputers, invited guest lecture at FFI, Norway, September 2013
- Introduction to Scientific Writing, invited intensive course at National University of Defense Technology, China, October 2013
- Adopting heterogeneous hardware platforms for scientific computing, invited guest lecture at Technical University of Denmark, December 2013

Organisational activities

- Program co-chair for ICPP-HPSEC05 Workshop, ICCS-IHPCES 2013 Workshop, PHSP14 Workshop, ICCS-IHPCES 2015 Workshop
- Organizer/co-organizer of minisymposia: User-friendly Parallel Programming: Methodologies and Tools at SIAM CSE'13, Advanced Computing in Geosciences at PARA'08, Software Tools for Parallel CFD Applications at PARA'06, Fusion of Information for Hydrologic Sciences at the WPGM 2006 Conference