

OMAR GHATTAS

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Biography and Synergistic Activities

Omar Ghattas is the John A. and Katherine G. Jackson Chair in Computational Geosciences in the Institute for Computational Engineering and Sciences; Director of the Center for Computational Geosciences and Optimization; Professor of Geological Sciences and Mechanical Engineering; and Professor of Biomedical Engineering and Computer Sciences (by courtesy) at the University of Texas at Austin. Prior to September 2005, he was Professor of Biomedical Engineering and Civil & Environmental Engineering, and Director of the Ultrascale Simulation Laboratory, at Carnegie Mellon University.

He received his BS, MS, and PhD from Duke University in 1984, 1986, and 1988, respectively. He joined CMU in 1989 after serving as a postdoctoral research associate at Duke. He has been a visiting professor at the Institute for Computer Applications in Science and Engineering (ICASE) at NASA-Langley Research Center; the Center for Applied Scientific Computing (CASC) at Lawrence Livermore National Laboratory; and the Computer Science Research Institute (CSRI) at Sandia National Laboratories.

Ghattas has general research interests in computational science and engineering, with emphasis on simulation and optimization of complex solid, fluid, and biomechanical systems, in particular inverse problems, optimal design, and optimal control. He specializes in large-scale problems, and their solution on parallel supercomputers. His research activities include serving as principal or co-principal investigator on nine multi-institution group grants: the Earthquake Ground Motion Modeling project (NSF Grand Challenge); the Computer-Assisted Surgery project (NSF National Challenge); the Inversion-Based Seismic Modeling project (NSF KDI); the Simulation of Flows with Dynamic Interfaces project (NSF ITR); the Real-Time Inversion and Control of Dynamic Simulations project (NSF ITR); the Terascale Optimal PDE Simulations project (DOE SciDAC); the Ultrascale Forward and Inverse Earthquake Earthquake Modeling project (NSF ITR); the Image-Driven Inverse Cardiac Modeling project (NSF ITR); and the Contaminant Source Inversion and Evolution Prediction project (NSF DDDAS).

His recent professional service activities have included membership on the review board for NSF's supercomputing centers (PACI) program; organization of several conferences and workshops in high performance scientific computing, including serving as chair of the organizing committee of the SIAM Conference on Computational Science and Engineering in 2003 and as co-organizer of the IMA Workshop on Simulation-Based Optimization in 2003 and Sandia Workshops on PDE-Constrained Optimization in 2001 and 2004; Program Director for SIAM's Computational Science & Engineering Activity Group; founding editor-in-chief of SIAM's *Computational Science and Engineering* series; Associate Editor of the *SIAM Journal on Scientific Computing*; editorial board member of the *Journal for Multiscale Computational Engineering* and *Computer Methods in Applied Mechanics and Engineering*; member of the SIAM Program Committee; and member of Science Steering Committee for the Computational Infrastructure for Geodynamics (CIG) project. He received the 1998 Allen Newell Medal for Research Excellence, the 2003 Gordon Bell Prize for Special Accomplishment in Supercomputing, and the 2004–2005 CMU College of Engineering Outstanding Research Prize with members of the Quake research project at CMU. His paper on inverse wave propagation with former students V. Akçelik and G. Biros received the SC2002 Best Technical Paper award.

Collaborators, last five years

Volkan Akçelik (SLAC), James Antaki (CMU), Roscoe Bartlett (Sandia), Jacobo Bielak (CMU), Lorenz Biegler (CMU), George Biros (Penn), Guy Blelloch (CMU), Alfio Borzi (Graz), Steven Day (SDSU), Christos Davatzikos (Penn), Andrei Draganescu (Sandia), Lori Diachin (LLNL), Sergey Fomel (Texas), William Gropp (Argonne), Eldad Haber (Emory), Judy Hill (Sandia), Matthias Heinkenschloss (Rice), Michael Hintermüller (Graz), Yoshiaki Hisada (Kogakuin University, Japan), Loukas Kallivokas (Texas),

Marina Kameneva (UPMC), David Keyes (Columbia), Kwok Ko (SLAC), Patrick Knupp (Sandia), Lie-Quan (Rich) Lee (SLAC), Kevin Long (Sandia), Kwan-Liu Ma (UC Davis), Gary Miller (CMU), Jan Modersitzki (Lübeck), Esmond Ng (LBNL), David O'Hallaron (CMU), K.R. Rajagopal (Texas A&M), Michael Sacks (UPMC), Jennifer Schopf (Argonne), Jonathan Shewchuk (Berkeley), Tim Tautges (Sandia), George Turkiyyah (Washington), John Urbanic (PSC), Bart van Bloemen Waanders (Sandia), Noel Walkington (CMU), Karen Willcox (MIT), David Young (Boeing), and other collaborators on the Terascale Optimal PDE Simulations (TOPS) DOE SciDAC Center listed at <http://tops-scidac.org>.

Advisor/Advisees

PhD advisor:: Robert Melosh (Duke); **Post-doc advisor:** Peter Haff (Duke). **Former PhD students:** Carlos Orozco (UNCC), Xiaogang Li (Algor), Jai-Hyeong Bark (Mok-Won University, Korea), Beichang He (GE CR&D), Jifeng Xu (Boeing), Hesheng Bao (Algor), George Biros (Univ. Penn), Ivan Malcevic (GE R&D), Volkan Akçelik (SLAC), Larisa Goldmints (RPI), Euijoong Kim (Duke), Clemens Kadow (McKinsey), Judy Hill (Sandia), Ioannis Epanomeritakis (Greece), Alexandre Cunha (UCLA), Ioanna Pagani. **Former post-docs:** Loukas Kallivokas (Texas-Austin), Beichang He, Euijoong Kim, Clemens Kadow, Volkan Akçelik, Alexandre Cunha, Judy Hill. **Current PhD students:** Aysegul Askan, Jennifer Dieringer, Pearl Flath, Shan Yang.

Ten Relevant Publications (available at <http://www.cs.cmu.edu/~oghattas>)

1. V. Akçelik, G. Biros, O. Ghattas, J. Hill, D. Keyes, and B. van Bloemen Waanders, Parallel PDE constrained optimization, in *Frontiers of Parallel Computing*, M. Heroux, P. Raghaven, and H. Simon, eds, SIAM. To appear, 2006.
2. V. Akçelik, G. Biros, A. Dragenescu, J. Hill, O. Ghattas, and B. van Bloemen Waanders, Dynamic data-driven inversion for terascale simulations: Real-time identification of airborne contaminants, *Proceedings of SC2005*, IEEE/ACM, Seattle, WA, November 2005.
3. T. Tu, D. O'Hallaron, and O. Ghattas, Scalable parallel octree meshing for terascale applications, *Proceedings of SC2005*, IEEE/ACM, Seattle, WA, November 2005.
4. G. Biros and O. Ghattas, *Parallel Lagrange-Newton-Krylov-Schur methods for PDE-constrained optimization. Part I: The Krylov-Schur solver*, SIAM Journal on Scientific Computing, 27(2):687–713, 2005.
5. G. Biros and O. Ghattas, *Parallel Lagrange-Newton-Krylov-Schur methods for PDE-constrained optimization. Part II: The Lagrange-Newton solver, and its application to optimal control of steady viscous flows*, SIAM Journal on Scientific Computing, 27(2):714–739, 2005.
6. V. Akçelik, J. Bielak, G. Biros, I. Epanomeritakis, A. Fernandez, O. Ghattas, E. Kim, J. Lopez, D. O'Hallaron, T. Tu, J. Urbanic, *High-resolution forward and inverse earthquake modeling on terascale computers*, Proceedings of SC2003, IEEE/ACM, Phoenix, AZ, Nov. 2003.
7. L. Biegler, O. Ghattas, M. Heinkenschloss, and B. van Bloemen Waanders, eds., *PDE-Constrained Optimization: State-of-the-Art*, Springer-Verlag, Lecture Notes in Computational Science and Engineering, 2003.
8. J. Xu, J. Bielak, O. Ghattas, and J. Wang, *Three-dimensional seismic ground motion modeling in inelastic basins*, Physics of the Earth and Planetary Interiors, 137(1–4):81–95, 2003.
9. V. Akçelik, G. Biros, and O. Ghattas, *Parallel multiscale Gauss-Newton-Krylov methods for inverse wave propagation*, Proceedings of SC2002, Baltimore, MD, IEEE/ACM, Nov. 2002.
10. J.F. Antaki, G.E. Blelloch, O. Ghattas, I. Malcevic, G.L. Miller, and N.J. Walkington, *A parallel dynamic-mesh Lagrangian method for simulation of flows with dynamic interfaces*, Proceedings of SC2000, IEEE/ACM, Dallas, TX, Nov. 2000.