Leopold Grinberg, PhD

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Education

- Ph.D. Applied Mathematics, Brown University, USA, 2009.
- Sc. M. Applied Mathematics, Brown University, USA, 2007.
- M. Sc. Department of Mechanical Engineering Ben-Gurion University of the Negev, Israel. 2003, *Cum Laude.*
- Physician Assistant, Kamensk-Uralsky Medical College, Russia, 1991, *Cum Laude.*

PhD Thesis (Applied Mathematics, Brown University)

"Topics in Ultrascale Scientific Computing with Application in Biomedical Modeling"
(available at http://www.dam.brown.edu/people/lgrinb/PhD_Thesis/Leopold_Grinberg_PhD_Thesis.pdf)

M.Sc Thesis (Mechanical Engineering, Ben-Gurion University)

"Numerical Simulation of a FlowThrough Stenosis" (available at
http://www.dam.brown.edu/people/lgrinb/Thesis_BGU/Leopold_Grinberg_MSc_Thesis_BGU.pdf)

Research Interests

- Parallel scientific computing
- High Performance Computing
- High-order spectral/*hp* methods
- Computational Fluid Dynamics
- Linear solvers
- Biomedical modeling
- Cardiovascular Flows
- Multiscale flow simulations

Computing Skills

- Parallel computing with MPI, OpenMP (and hybrid), MPIg, MPICH-G2
- Scaling (strong) applications up to 300K cores of BG/P; 190K cores of Cray XT5
- Design and programming solvers using multilayer task and data parallelism, intrinsics, pragma directed SSE
- Grid Computing: cross-site simulations on TeraGrid
- Languages: C++, Matlab, Fortran
- Platforms: IBM BlueGene, CRAY XT3/4/5, XE6, XK6; Linux Cluster.

Work Experience

- Consultant, MIT SeaGrant Program, (2011-present) (CFD, HPC, simulations of marine propellers)
- Senior Research Associate, Division of Applied Mathematics, (2009-present)
- Lecturer, Division of Applied Mathematics, Brown University (2010-2011)
- Lecturer, Department of Computer Science, Tufts University (2010)
- Graduate research assistant, Division of Applied Mathematics, Brown University (2003-2009)
- Teaching Assistant, Dep. of Mechanical Eng., Ben Gurion University (2001-2003)
- Mechanical Engineer, Department of High Density Plasma, Intel, (2000)

Honors and Awards

- Honorable Mention ACM Award for paper "A new computational paradigm in multiscale simulations: Application to brain blood flow" (2011) .
- People's Choice OASCR Award, SciDAC visualization, (2011).
- The Best Poster Award, Supercomputing'08 (2008).
- Fulbright, United States-Israel Education Foundation (2003).
- Wolf Foundation Award, Israel (2003).

Teaching Experience

- Introduction to High Performance Computing: tools and algorithms, Instructor (Universidade Estadual De Campinas, Brazil, fall 2010 and 2011)
- Introduction to High Performance Computing: tools and algorithms, Instructor (Brown University, spring 2010 and spring 2011)
- Introduction to High Performance Computing: tools and algorithms, Lecturer (Tufts University, spring 2010)
- Parallel Scientific Computing: Algorithms and Tools, Co-Instructor (Brown University, 2008)
- MATLAB, Instructor (2001-2003)
- Numerical Methods, Teaching Assistant (2001-2003)
- Calculus, Teaching Assistant (2002-2003, 2008)

Sc.B. Thesis co-advisor

- Elizabeth Cheever, "One Dimensional Simulations of Cerebral Blood Flow" A thesis submitted for Honors for the degree of Sc.B. Applied Mathematics – Computer Science (Brown University, 2009).
- Susanna Makela, Applied Mathematics (Brown University, 2008).

Publications

- **L. Grinberg**, V. Morozov, K. Kumaran and G. E. Karniadakis, *Early experience in development hybrid MPI-OpenMP solvers on IBM BlueGene/Q and Cray XK6* supercomputers, First International Conference on Communications, Computation, Networks and Technologies, (accepted, 2012).
- **L. Grinberg**, *Proper Orthogonal Decomposition of Atomistic Flow Simulations*. Journal of Computational Physics, **231**(16):5542–5556 (2012).
- **L. Grinberg**, M. Deng, H. Lei, J. A. Insley and G. E. Karniadakis, *Multiscale Simulations of Blood-Flow: From a Platelet to an Artery*, XSEDE 2012 conference, Chicago, IL. (accepted, 2012)
- **L. Grinberg**, D. Fedosov and G. E. Karniadakis, *Parallel multiscale simulations of a brain aneurysm*, Journal of Computational Physics (2012, accepted with minor revision).
- **L. Grinberg**, V. Morozov, D. Fedosov, J. Insley, M. Papka, K. Kumaran and G. E. Karniadakis, A new Computational *Paradigm in Multiscale Simulations.* In Proceedings of the 2011 ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis, SC'11. (**Gordon Bell Prize finalist**).
- J. A. Insley, **L. Grinberg,** M. E. Papka**,** *Visualizing Multiscale Simulation Data: Brain Blood Flow*. Proceedings of IEEE Symposium on Large-Scale Data Analysis and Visualization, Providence, RI, (2011).
- J. A. Insley, **L. Grinberg,** M. E. Papka**,** *Visualization of Multiscale Simulation Data: Brain Blood Flow*, TeraGrid '11 Conference, Salt Lake City, UT (2011).
- **L. Grinberg** and G. E. Karniadakis, *Parallel Paradigm for Ultraparallel Multi-Scale Brain Blood Flow Simulation.* Proceedings of the Second International Conference on Parallel, Distributed, Grid and Cloud Computing for Engineering, (2011).
- **L. Grinberg,** E. Cheever, T. Anor, J. R. Madsen and G. E. Karniadakis, *Modeling Blood Flow Circulation in Intracranial Arterial Networks: A Comparative 3D/1D Simulation Study*. Annals of Biomedical Engineering, **39**(1):297-309 (2011).

- **L. Grinberg** and G. E. Karniadakis, *Extrapolation-based Acceleration of Iterative Solvers: Application to Simulation of 3D Flows.* 9(3):607-626 (2010).
- **L. Grinberg** and G. E. Karniadakis*, A new domain decomposition method with overlapping patches for ultrascale simulations: Application to biological flows. Journal* of Computational Physics. **229**(15):5541-5563 (2010).
- T. Anor, **L. Grinberg**, H. Baek, M. V. Jayaraman , J. R. Madsen and G. E. Karniadakis, *Modeling of large blood vessels.* Wiley: interdisciplinary reviews, System Biology. **2**(5):612-623 (2010).
- **L. Grinberg**, A. Yakhot and G. E. Karniadakis, *Analyzing Transient Turbulence in a Stenosed Carotid Artery by Proper Orthogonal Decomposition.* Annals of Biomedical Engineering, ***37***(11), 2200-2217 (2009).
- **L. Grinberg**, T. Anor, E. Cheever, J. R. Madsen and G. E. Karniadakis, *Simulation of the Human Intracranial Arterial Tree*, Philosophical Transactions of the Royal Society A, **367**(1896), 2371-2386 (2008) .
- **L. Grinberg**, D. Pekurovsky, S. Sherwin and G. E. Karniadakis, *Parallel Performance of the Coarse Space Linear Vertex Solver and Low Energy Basis Preconditioner for Spectral/hp Elements*, Parallel Computing, **35**(5), 284-304 (2008).
- **L. Grinberg** and G. E. Karniadakis**,** *A Scalable Domain Decomposition Method for Ultra-Parallel Arterial Flow Simulations***,** Communications in Computational Physics; **4**, 1151-1169 (2008).
- **L. Grinberg** and G. E. Karniadakis, *Outflow Boundary Conditions for Arterial Networks with Multiple Outlets*, Annals of Biomedical Engineering, **36**(9), 1496-1514 (2008).
- **L. Grinberg**, T. Anor, J. R. Madsen, A. Yakhot and G. E. Karniadakis, *Large-Scale Simulation of the Human Arterial Tree*, Clinical and Experimental Pharmacology and Physiology, **36**(2), 194-205 (2009).
- **L. Grinberg** and G. E. Karniadakis, *Hierarchical spectral basis and Galerkin formulation using barycentric quadrature grids in triangular elements*, Journal of Engineering Mathematics, **56**(3), 289-306 (2007).
- G. Lin, **L. Grinberg** and G. E. Karniadakis, *Numerical studies of the stochastic Korteweg-de Vries equation,* Journal of Computational Physics, **213**(2), 676-703 (2006).
- A. Yakhot, **L. Grinberg** and N. Nikitin, *Modeling rough stenoses by an immersed-boundary method,* Journal of Biomechanics **38**(5), 1115-1127 (2005).
- A. Yakhot, **L. Grinberg** and N. Nikitin, *Simulating pulsatile flows through a pipe orifice by an immersed-boundary method*, Journal of Fluids Engineering **126**(6), 911-918 (2004).
- A. Yakhot and **L. Grinberg**, *Phase shift ellipses for pulsating flows,* Physics of fluids **77**(15), 2081-2083 (2003).

Conferences

- **L. Grinberg,** V. Morozov, D. Fedosov, J. Insley, M. Papka, K. Kumar and G. E. Karniadakis, *A new Computational Paradigm in Multiscale Simulations.* ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis, SC'11, Seattle, WA, (November 2011).
- **L. Grinberg** and G. E. Karniadakis, *Parallel Paradigm for Ultraparallel Multi-Scale Brain Blood Flow Simulations*, Second International Conference on Parallel, Distributed, Grid and Cloud Computing for Engineering, Ajaccio, Corsica, France (April, 2011).
- **L. Grinberg** and G. E. Karniadakis, *Multiscale patient-specific modeling of brain blood flow,* MITACS-Fields Conference on the Mathematics of Medical Imaging, special session on Computational Hemodynamic Imaging, Toronto, Canada (June 2011).
- **L. Grinberg** and G. E. Karniadakis, *High Resolution Simulation of the Intracranial Arterial Network*, SIAM Conference on Computational Science and Engineering (CSE11), Reno, NV (Feb.-March 2011).
- **L. Grinberg** and G. E. Karniadakis, *A new approach in processing atomistic simulations,* 63rd

Annual Meeting of the APS Division of Fluid Dynamics, Long Beach, CA (November 2010).

- **L. Grinberg** and G. E. Karniadakis, *High-Resolution Flow Simulation in Arterial Network of the Brain*, Virtual Physiological Human, Brussels, Belgium (September 2010).
- **L. Grinberg,** D. Fedosov, B. Caswell and G. E. Karniadakis**,** *Multi-scale blood flow simulations in the human arterial tree,* Virtual Physiological Human Conference, Brussels, Belgium (September 2010).
- P. E. Vincent, A. Hunt, **L. Grinberg**, S. Sherwin, P. Weinberg, *A Realistic Representation of the Rabbit Aorta for use in Computational Haemodynamic Studies*. ASME Conference Proceedings 2009, 985:986 (2009)
- **L. Grinberg,** A. Yakhot and G. E. Karniadakis, *Analyzing Transient Turbulence in a Stenosed Carotid Artery by Proper Orthogonal Decomposition*, 62nd Annual Meeting of the APS Division of Fluid Dynamics, Minneapolis, MN (November 2009).
- **L. Grinberg** and G. E. Karniadakis, *High Resolution Simulation of the Human Arterial Tree with Two- level Domain Decomposition,* 10th US National Congress on Computational Mechanics, Columbus, Ohio (July 2009).
- **L. Grinberg** and G. E. Karniadakis, *Scalable Solvers for Spectral/hp Elements*, International Conference on Spectral and High Order Methods, Trondheim, Norway (June 2009).
- **L. Grinberg** and G. E. Karniadakis, *Spectral Element Simulation of Transient Turbulence in a Stenosed Carotid Artery*, International Conference on Spectral and High Order Methods, Trondheim, Norway (June 2009).
- **L. Grinberg** and G. E. Karniadakis**,** *Unsteady 3D flow simulations in cranial arterial tree,SIAM Conference on Computational Science and Engineering(CSE09),* Miami, FL (2009).
- **L. Grinberg** and G. E. Karniadakis, *Unsteady 3D flow simulations in cranial arterial tree*, 61st Annual Meeting of the APS Division of Fluid Dynamics, San Antonio, TX (November 2008).
- **L. Grinberg** and G. E. Karniadakis, *Large scale 3D Arterial Flow Simulation with Hierarchical Domain Decomposition Method*, 16th Congress of the European Society of Biomechanics, Lucerne, Switzerland (July, 2008).
- **L. Grinberg,** B. Toonen, N. Karonis and G. E. Karniadakis, *A Multilayer Approach to Simulate Large Multiscale Computational Mechanics Problems Using Grids*, Open Source Grid and Cluster Software, Oakland, CA (May 2008).
- **L. Grinberg,** A. Yakhot and G. E. Karniadakis, *Onset of Turbulence in a Stenosed Carotid Artery,* Inaugural International Conference of the Engineering Mechanics Institute, Minneapolis, MN (May 2008)
- **L. Grinberg** and G. E. Karniadakis, *A Multiscale Model for the Brain Vascular Network* , 60th Annual Meeting of the APS Division of Fluid Dynamics , Salt Lake City (2007).
- **L. Grinberg** and G. E. Karniadakis, *Spectral/hp Element Simulation of the Human Arterial Tree on the TeraGrid* , USNCCM9 , San Francisco, CA (2007).
- **L. Grinberg**, B. Toonen, N. Karonis and G. E. Karniadakis, *A New Domain Decomposition Technique for TeraGrid Simulations* , TeraGrid '07 , Madison, WI, (2007).
- **L. Grinberg** and G. E. Karniadakis, *Decomposition of the Spectral Element Mesh in TeraGrid Simulation of the Human Arterial Tree,* ICOSAHOM, Beijing, China, (2007).
- S. Dong, **L. Grinberg**, A. Yakhot, S. Sherwin and G. E. Karniadakis, *Simulation of Blood Flow in Human Arterial Tree on the TeraGrid* , SIAM Conference on Parallel Processing for Scientific Computing , San Francisco, CA, Feb. (2006).
- **L. Grinberg,** A. Yakhot and G. E. Karniadakis, *DNS of Flow in Stenosed Carotid Artery*, 59th Annual Meeting of the APS Division of Fluid Dynamics , Tampa, FL, (2006).
- **L. Grinberg** and G. E. Karniadakis, *The Tale of Two Spectral Bases on the Triangle*, USNCCM8, Austin, TX (2005).
- S. Dong, **L. Grinberg,** A. Yakhot, S. Sherwin and G. E. Karniadakis, *TeraGrid Simulations of Blood Flow in Human Arterial Tree*, 58th Annual Meeting of the APS Division of Fluid Dynamics, Chicago, IL, (2005).

Presentations/Seminars

- **L. Grinberg**, *A new Computational Paradigm in Multiscale Simulations: Application to Brain Blood Flow,* Dep. Mathematics and Computer Science, Emory University (January 2012).
- **L. Grinberg**, *The Arterial Tree Project,* Laboratório Nacional de Computação Científica (LNCC), Brazil (December 2011).
- **L. Grinberg**, A new Computational *Paradigm in Multiscale Simulations*, Universidade Estadual de Campinas (UNICAMP), Brazil (November 2011).
- **L. Grinberg**, *Muti-scale Simulations of Cerebral Blood Flow*, BIDMC Center for Vascular Biology Research, Boston (May 2011).
- **L . Grinberg***, High Performance Scientific Computing – A New Physician Assistant,* Brighamand William Hospital, Boston (2010).
- **L. Grinberg,** *A Scalable Domain Decomposition Method for Ultra-Parallel Arterial Flow Simulations,* Computational Engineering & Science/HPC workshop, Lehigh University, (2009).
- **L. Grinberg,** *Large Scale Simulation of the Human Arterial Tree,* Boston University, Mechanical Engineering Department, January 23, 2009.
- **L. Grinberg,** *Ultrascale Simulation of the Human Intracranial Arterial Tree,* SC08, Austin, TX (2008).
- **L. Grinberg**, *Large scale 3d arterial flow simulation with hierarchical domain decomposition method*, (seminar) Institut Jean le Rond d'Alembert, Université Paris 6 July 17, 2008**.**
- **L. Grinberg** and G. E. Karniadakis, *Terascale Simulation of Arterial Blood Flow on the TeraGrid*, SC07, Reno, NV (2007) (**invited talk**).
- **L. Grinberg**, K. Eschenberg and N. Stone, *Real-Time Visualization for Terascale Simulations with Spectral/hp Element Methods, SC07, Reno, NV (2007).*
- **L. Grinberg** and G. E. Karniadakis, *Multi-Level Parallel Paradigm and Domain-Decomposition Technique for Human Arterial Tree Simulation,* SC07, Reno, NV (2007).
- **L. Grinberg**, *Multilevel Parallelism and Locality-Aware Algorithms,* Petascale Applications Symposium, Pittsburgh Supercomputing Center, PA (2007).
- **L. Grinberg**, K. Eschenberg and N. Stone, *Interactive Insight to Ongoing Computations,* SC06, Tampa, FL (2006).
- S. Dong, **L. Grinberg**, J. Insley, N. Karonis, S. Spencer and G. E. Karniadakis *TeraGrid Cross-Site Simulations and Visualizations of the Human Arterial Tree*, SC05 , Seattle, WA (2005).

Posters

- J. Insley, **L. Grinberg**, M. Papka and G. E. Karniadakis. *Visualizing Multiscale Simulation Data* SC'11*,* Seattle, WA (2011).
- **L. Grinberg**, J. Insley, M. Papka and G. E. Karniadakis. *Brain Perfusion: Multi-scale Simulations and Visualization* IMA Workshop, Minneapolis, MN (2011).
- **L. Grinberg**, J. Insley, M. Papka and G. E. Karniadakis. *Brain Blood Flow: Multi-scale Simulations and Visualization,* SC10, New Orleans, LA (2010).
- P. E. Vincent, A. Hunt, **L. Grinberg**, S. Sherwin, P. Weinberg, *A Realistic Representation of the Rabbit Aorta for use in Computational Haemodynamic Studies*. Poster Presentation, American Society of Mechanical Engineering, Summer Bioengineering Conference, 17-21 June 2009. Lake Tahoe, California, USA. (Finalist in poster prize competition).
- **L. Grinberg**, J. Cazes, G. Foss and G. E. Karniadakis. *A Scalable Domain Decomposition Method for Ultra-Parallel Arterial Flow Simulations,* SC09, Portland, OR (2009).
- **L. Grinberg**, J. Cazes and G. E. Karniadakis. *A Scalable Domain Decomposition Method for Ultra-Parallel Arterial Flow Simulation,* SC08, Austin, TX (2008, "**the Best Poster**" award winner).

- **L. Grinberg**, J. Cazes and G. E. Karniadakis. *A Scalable Domain Decomposition Method for Ultra-Parallel Arterial Flow Simulation,* Fast Algorithms for Scientific Computing, NYU, New York, NY (2008).
- *T. Anor,* **L. Grinberg**, J. R. Madsen and G. E. Karniadakis, *Large-scale Simulations of the Human Cranial Arterial tree: Utility in Hydrocephalus,* 52nd Annual Scientific Meeting, Society for Research into Hydrocephalus and Spina Bifida , Providence, RI (2008).
- **L. Grinberg**, S. Dong, J. Noble, A. Yakhot, G. E. Karniadakis and N.T. Karonis, *Human arterial tree simulation on TeraGrid*, SC06, Tampa, FL (2006).

Organized sessions and workshops

- Workshop on High-order methods and High-Performance Computing, University of Campinas, Brazil (November-December 2011)
- WCCM: High-order methods in computational mechanics, Sao Paulo, Brazil (July, 2012).
- SIAM: Parallel Processing for Scientific Computing, High Performance Computing in Biomedical Research, Seattle, WA (2010).

Workshops Participation:

- CECAM Worshop on Reduced Basis, POD and Reduced Order Methods for model and computational reduction: towards real-time computing and visualization. Invited speaker. Presentation: "*Window Proper Orthogonal Decomposition: application to continuum and atomistic flow simulations*". EPFL, Switzerland, May 14-16, 2012
- IMA Workshop on High Performance Computing and Emerging Architectures, Minneapolis, MN, January 10-14, 2011.
- Computational Engineering & Science/HPC workshop, Lehigh University, October 5-6, 2009. Invited speaker. Presentation: "*A Scalable Domain Decomposition Method for Ultra-Parallel Arterial Flow Simulations".*
- Envisioning XD [Extreme Digital] User Requirement Meeting, San-Diego Supercomputing Center, July 2009.
- Enabling Science Discoveries through Visual Exploration, National Science Foundation, Washington D.C, September 27-28, 2007.

Funded Proposals

- "Hybrid Computing Facilities Enabling Novel Algorithm Developments for Stochastic Simulations and Research-related Education"($400,227, funded by AFSOR,Co-PI)
- INCITE allocation by DoE, 50M core-hours on BlueGene/P at ANL, 23M core-hours on CRAY at ORNL (co-PI)

Professional Service

- Referee for Journal of Computational Physics
- Referee for Journal of Engineering Mathematics
- Referee for International Journal of High Performance Computing Applications
- Referee for Medical Engineering & Physics
- Referee for The International Conference for High Performance Computing, Networking, Storage, and Analysis
- Referee for Computer Methods and Programs in Biomedicine
- Referee for Computing in Science and Engineering
- Referee for Journal of Biomechanical Engineering
- Referee for Journal Mathematics and Computers in Simulation
- Referee for International Journal of Computer Assisted Radiology and Surgery