





Harsh Bhatia

COMPUTER SCIENTIST

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Research Interests

Scientific Visualization and Data Analysis · Computational Science and Scientific Computing · Computational Topology and Computational Geometry · High-Performance Computing · Statistical Methods and Machine Learning · Mathematical Modeling and Simulation · Data Science · Algorithm Design

Education

Ph.D. in Computing: Graphics and Visualization

May 2015

Scientific Computing and Imaging (SCI) Institute, The University of Utah, Salt Lake City, USA

Thesis: *Consistent Feature Extraction From Vector Fields: Combinatorial Representations and Analysis Under Local Reference Frames*

Advisors: Prof. Valerio Pascucci & Dr. Peer-Timo Bremer

B.Tech. in Information and Communication Technology

June 2007

Dhirubhai Ambani Institute of Information and Communication Technology (DAIICT), Gandhinagar, India

Thesis: *Application of QNA to analyze the 'Queueing Network Mobility Model' of Mobile Ad-hoc Networks*

Advisor: Dr. R.B. Lenin

Experience

Computer Scientist, CASC, Lawrence Livermore National Laboratory, Livermore, USA

Feb. 2017 – Current

- Developing new framework for adaptive precision computing for scientific applications.
- Developing new analysis and machine learning techniques to support multiscale simulation of lipid bilayers for cancer research.
- Developing new visualization tools for exploring performance data on supercomputers.

Postdoctoral Researcher, CASC, Lawrence Livermore National Laboratory, Livermore, USA

Dec. 2014 – Feb. 2017

- Developed new tools and techniques for exploring atomic diffusion and solvation in Li-ion battery simulations.
- Developed new tools and techniques for visual analysis of network traffic on InfiniBand networks for super computers.

Lawrence Scholar, CASC, Lawrence Livermore National Laboratory, Livermore, USA

Jan. 2012 – Nov. 2014

- Developed a new variant of a 160 year old flow decomposition to remove well-known artifacts due to required boundary conditions.
- Developed new frames of reference for robust analysis of time-dependent flow with lower computational cost and better data management.

Summer Intern, CASC, Lawrence Livermore National Laboratory, Livermore, USA

Summer 2010 & 2011

- Surveyed the "Helmholtz-Hodge decomposition (HHD)" for vector fields, and its applications in science and engineering.
- Identified and published a mathematical error in a recently-published computation technique for the HHD.

Graduate Research Assistant, SCI Institute, The University of Utah, Salt Lake City, USA

Jan. 2009 – Jan. 2012

- Developed new combinatorial representations and algorithms for consistent and numerically-robust analysis and visualization of 2D flows.
- Developed a new combinatorial algorithm for consistent and numerically-robust detection of critical points in piecewise linear vector fields.

Teaching Assistant, School of Computing, The University of Utah, Salt Lake City, USA

Fall, 2009

Graduate Course on Algorithms (CS 6150). · Parallel Programming (CS 4960).

Software Engineer, Infosys Technologies Ltd., Bangalore, India

Jul. 2007 – May. 2008

- Designed and implemented improvements in Enterprise Application Software and multi-tier application environment [C, C++, and SAP].

Software Intern, Tata Consultancy Services, Ahmedabad, India

Summer 2005

- Designed and implemented elements of the MVC architecture for web services [Java, HTML, JSP, and JavaScript].

Instructor, DAIICT, Gandhinagar, India

Mar. 2006

- "Discrete Event Simulation using OMNeT++" (In a 2-day IEEE workshop on 'Simulation in Information & Communication Technology')

Undergraduate Research Assistant, DAIICT, Gandhinagar, India

2006 – 2007

- Extended the 'Queueing Network Mobility Model' of mobile ad-hoc networks to scenarios with gated nodes, i.e., nodes with failures.

Honors & Awards

2018	Spot Award for Outstanding contributions in Center for Applied Scientific Computing	Livermore, US
2016	Best paper award at IEEE Pacific Visualization Symposium	Taipei, Taiwan
2014	Invitation to participate in the 2 nd Heidelberg Laureate Forum (attendance by invitation only)	Heidelberg, Germany
2012	4-year graduate fellowship awarded by Livermore Graduate Scholar Program, LLNL	Livermore, USA
2011	Best paper award at IEEE Pacific Visualization Symposium	Hong Kong
2007	3rd prize in the RedHat Challenge for a technical business idea (1 st MIT, USA; 2 nd McGill Univ., Canada)	Online
2006	1st prize in 'Catechise' — the networking quiz	Gandhinagar, India
2005	Among top 5 projects in D. A. Developer Program: RPG design for Java-enabled CDMA phones	Gandhinagar, India
2005	3rd place in Osmosis technical paper contest	Bangalore, India
2002	All India rank 93 in the National Science Olympiad (high-school level)	India
2001	All India rank 124 in the National Science Olympiad (high-school level)	India

Professional Activities

2011	Invited Panel Participant , Views from the academic world on collaborative research	Salt Lake City, USA
2006	Workshop Organizer , Discrete Event Simulation using OMNeT++	Gandhinagar, India
2006	Event Organizer , The Algorhythmus — Algorithm and Programming contest	Gandhinagar, India

AREA EDITOR

ACM SIGCAS Newsletter—Graphics and Visualization [2016, 2017]

INTERNATIONAL PROGRAM COMMITTEE MEMBERSHIP

Eurographics Conference on Visualization (EuroVis) [2016, 2017, 2018] · International Workshop on Visual Performance Analysis [2017] · Eurographics Symposium on Parallel Graphics and Visualization [2015]

TECHNICAL REVIEWING

IEEE Transactions on Visualization and Computer Graphics (TVCG) [2015, 2016, 2017] · Computer Graphics Forum (CGF) [2014, 2016, 2017] · Journal of Parallel and Distributed Computing [2017] · IEEE VIS [2013, 2014, 2015, 2016, 2017] · Eurographics Conference on Visualization (EuroVis) [2013, 2014, 2015, 2016, 2017] · IEEE Pacific Visualization [2014, 2016, 2017] · Workshop on Visual Performance Analysis (VPA) [2017] · Conference on Visualization and Data Analysis (VDA) [2016] · Computer Methods and Programs in Biomedicine [2015] · Topological and Statistical Methods for Complex Data [2014]

PROFESSIONAL MEMBERSHIPS

Institute of Electrical and Electronics Engineers (IEEE) · Association for Computing Machinery (ACM)

Publications

REFEREED JOURNAL ARTICLES

- [A-14] D. Hoang, P. Klacansky, **Harsh Bhatia**, P.-T. Bremer, P. Lindstrom, and V. Pascucci. A study of the trade-off between reducing precision and reducing resolution for data analysis and visualization. *IEEE Trans. Vis. Comput. Graph.*, 2018. To appear. doi:10.1109/TVCG.2018.2864853.
- [A-13] **Harsh Bhatia**, N. Jain, A. Bhatela, Y. Livnat, J. Domke, V. Pascucci, and P.-T. Bremer. Interactive investigation of traffic congestion on fat-tree networks using TREESCOPE. *Computer Graphics Forum*, 37(3):561–572, Jun 2018. doi:10.1111/cgf.13442.
- [A-12] **Harsh Bhatia**, A. G. Gyulassy, V. Lordi, J. E. Pask, V. Pascucci, and P.-T. Bremer. TOPOMS: Comprehensive topological exploration for molecular and condensed-matter systems. *Journal of Computational Chemistry*, 39(16):936–952, Jun 2018. doi:10.1002/jcc.25181.
- [A-11] H. I. Ingólfsson, T. S. Carpenter, **Harsh Bhatia**, P.-T. Bremer, S. J. Marrink, and F. C. Lightstone. Computational lipidomics of the neuronal plasma membrane. *Biophysical Journal*, 113(10):2271–2280, 2017. doi:10.1016/j.bpj.2017.10.017.
- [A-10] M. T. Ong, **Harsh Bhatia**, A. G. Gyulassy, E. W. Draeger, V. Pascucci, P.-T. Bremer, V. Lordi, and J. E. Pask. Complex ion dynamics in carbonate lithium-ion battery electrolytes. *The Journal of Physical Chemistry C*, 121(12):6589–6595, 2017. doi:10.1021/acs.jpcc.7b02006.
- [A-9] P. Skraba, P. Rosen, B. Wang, G. Chen, **Harsh Bhatia**, and V. Pascucci. Critical point cancellation in 3D vector fields: Robustness and discussion. *IEEE Trans. Vis. Comput. Graph.*, 22(6):1683–1693, Jun 2016. doi:10.1109/TVCG.2016.2534538. [Best Paper Award]
- [A-8] **Harsh Bhatia**, B. Wang, G. Norgard, V. Pascucci, and P.-T. Bremer. Local, smooth, and consistent Jacobi set simplification. *Comp. Geom. – Theor. Appl.*, 48(5):311–332, May 2015. doi:10.1016/j.comgeo.2014.10.009.
- [A-7] **Harsh Bhatia**, V. Pascucci, and P.-T. Bremer. The natural Helmholtz-Hodge decomposition for open-boundary flow analysis. *IEEE Trans. Vis. Comput. Graph.*, 20(11):1566–1578, Nov 2014. doi:10.1109/TVCG.2014.2312012.

- [A-6] **Harsh Bhatia**, V. Pascucci, R. M. Kirby, and P.-T. Bremer. Extracting features from time-dependent vector fields using internal frames of reference. *Comput. Graph. Forum*, 33(3):21–30, Jun 2014. doi:10.1111/cgf.12358.
- [A-5] **Harsh Bhatia**, G. Norgard, V. Pascucci, and P.-T. Bremer. The Helmholtz-Hodge decomposition – A survey. *IEEE Trans. Vis. Comput. Graph.*, 19(8):1386–1404, Aug 2013. doi:10.1109/TVCG.2012.316. [IEEE TVCG Spotlight of the Month]
- [A-4] B. Wang, P. Rosen, P. Skraba, **Harsh Bhatia**, and V. Pascucci. Visualizing robustness of critical points for 2D time-varying vector fields. *Computer Graphics Forum*, 32(3pt2):221–230, Jun 2013. doi:10.1111/cgf.12109.
- [A-3] **Harsh Bhatia**, G. Norgard, V. Pascucci, and P.-T. Bremer. Comments on the “Meshless Helmholtz-Hodge decomposition”. *IEEE Trans. Vis. Comput. Graph.*, 19(3):527–528, Mar 2013. doi:10.1109/TVCG.2012.62.
- [A-2] **Harsh Bhatia**, S. Jadhav, P.-T. Bremer, G. Chen, J. A. Levine, L. G. Nonato, and V. Pascucci. Flow visualization with quantified spatial and temporal errors using edge maps. *IEEE Trans. Vis. Comput. Graph.*, 18(9):1383–1396, Sep 2012. doi:10.1109/TVCG.2011.265.
- [A-1] J. A. Levine, S. Jadhav, **Harsh Bhatia**, V. Pascucci, and P.-T. Bremer. A quantized boundary representation of 2D flows. *Comput. Graph. Forum*, 31(3pt1):945–954, Jun 2012. doi:10.1111/j.1467-8659.2012.03087.x.

REFEREED BOOK CHAPTERS AND PUBLICATIONS IN CONFERENCE PROCEEDINGS

- [C-7] B. Wang, R. Bujack, P. Rosen, P. Skraba, **Harsh Bhatia**, and H. Hagen. Interpreting Galilean invariant vector field analysis via extended robustness. In *Topological Methods in Data Analysis and Visualization (TopoInVis)*. 2017. To appear.
- [C-6] **Harsh Bhatia**, A. G. Gyulassy, M. Bremer, M. T. Ong, V. Lordi, E. W. Draeger, J. E. Pask, V. Pascucci, and P.-T. Bremer. Interactive exploration of atomic trajectories through relative-angle distribution and associated uncertainties. In *Proc. of IEEE Pacific Vis. Symp.*, pages 120–127, Apr 2016. doi:10.1109/PACIFICVIS.2016.7465259.
- [C-5] A. Gyulassy, **Harsh Bhatia**, P.-T. Bremer, and V. Pascucci. Computing accurate Morse-Smale complexes from gradient vector fields. In J. Bennett, F. Vivodtzev, and V. Pascucci, editors, *Topological and Statistical Methods for Complex Data – Tackling Large-Scale, High-Dimensional, and Multivariate Data Sets*, Mathematics and Visualization, pages 205–218. Springer Berlin Heidelberg, 2015. doi:10.1007/978-3-662-44900-4_12.
- [C-4] **Harsh Bhatia**, A. Gyulassy, H. Wang, P.-T. Bremer, and V. Pascucci. Robust detection of singularities in vector fields. In P.-T. Bremer, I. Hotz, V. Pascucci, and R. Peikert, editors, *Topological Methods in Data Analysis and Visualization III – Theory, Algorithms, and Applications*, Mathematics and Visualization, pages 3–18. Springer Berlin Heidelberg, 2014. doi:10.1007/978-3-319-04099-8_1.
- [C-3] S. Jadhav, **Harsh Bhatia**, P.-T. Bremer, J. A. Levine, L. G. Nonato, and V. Pascucci. Consistent approximation of local flow behavior for 2D vector fields using edge maps. In R. Peikert, H. Hauser, H. Carr, and R. Fuchs, editors, *Topological Methods in Data Analysis and Visualization II – Theory, Algorithms, and Applications*, Mathematics and Visualization, pages 141–159. Springer Berlin Heidelberg, 2012. doi:10.1007/978-3-642-23175-9_10.
- [C-2] **Harsh Bhatia**, S. Jadhav, P.-T. Bremer, G. Chen, J. A. Levine, L. G. Nonato, and V. Pascucci. Edge maps: Representing flow with bounded error. In *Proc. of IEEE Pacific Vis. Symp.*, pages 75–82, Mar 2011. doi:10.1109/PACIFICVIS.2011.5742375. [Best Paper Award]
- [C-1] **Harsh Bhatia**, R. B. Lenin, A. Munjal, S. Ramaswamy, and S. Srivastava. A queuing-theoretic framework for modeling and analysis of mobility in WSNs. In *Proc. of the 8th Workshop on Performance Metrics for Intelligent Systems (PerMIS)*, pages 248–253, Aug 2008. doi:10.1145/1774674.1774713.

DISSERTATIONS

- [D-2] **Harsh Bhatia**. *Consistent Feature Extraction From Vector Fields: Combinatorial Representations and Analysis Under Local Reference Frames*. PhD thesis, The University of Utah, Salt Lake City, USA, May 2015. doi:10.2172/1341967.
- [D-1] **Harsh Bhatia**. *Application of QNA to analyze the ‘Queueing Network Mobility Model’ of Mobile Ad-hoc Networks*. B. Tech. project report, Dhirubhai Ambani Institute of Information and Communication Technology, Gandhinagar, India, June 2007.

NON-REFEREED ARTICLES AND TECHNICAL REPORTS

- [N-3] **Harsh Bhatia**. Enabling discovery through visual exploration: An introduction to data visualization & its applications. *SIGCAS Comput. Soc.*, 46(3), Nov. 2016. doi:10.1145/3024949.3024952.
- [N-2] **Harsh Bhatia**, A. Gyulassy, M. T. Ong, V. Lordi, E. W. Draeger, J. E. Pask, V. Pascucci, and P.-T. Bremer. Understanding lithium solvation and diffusion through topological analysis of first-principles molecular dynamics. Technical Report LLNL-TR-704318, Lawrence Livermore National Laboratory, Livermore, USA, Sep. 2016. doi:10.2172/1331475.
- [N-1] S. Jadhav, **Harsh Bhatia**, P.-T. Bremer, J. A. Levine, L. G. Nonato, and V. Pascucci. Consistent approximation of local flow behavior for 2D vector fields using edge maps. Technical Report UUSCI-2010-004, SCI Institute, The University of Utah, Salt Lake City, USA, 2010.

