Harsh Bhatia

SENIOR STAFF RESEARCH SCIENTIST

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SUMMARY

- 8+ years of post-Ph.D. R&D experience; proven track record of delivering innovative solutions for scientific problems using *Computer Science*, *Machine Learning*, *High-performance Computing*, *Computer Graphics*, and *Data Visualization*; demonstrated ability for technical leadership of multidisciplinary teams and cross-functional collaborations.

- 40+ publications in top-tier journals and conference venues; Best Paper at Supercomputing 2019; 8 additional Best Paper and Excellence in Publication Awards; research featured on several journal covers and news articles.

- Strong track record of designing and authoring open-source scientific software; expertise in software development, deep learning frameworks, database technologies, HPC, visualization and rendering tools, shell scripting, and version control.

EDUCATION

Ph.D. in Computing: Graphics and Visualization, SCI Institute, The University of Utah, Salt Lake City, USA *May 2015*

B.Tech. in Information and Communication Technology, DA-IICT, Gandhinagar, India *June 2007*

EXPERIENCE

Senior Staff Research Scientist, Samsung Research America, Mountain View, USA *Sep. 2022 – Current*

- Technical lead for the development of a scalable DL build pipeline for delivering GPU-ready models for deployment. Mentoring research and engineering staff and students. Contributing to R&D of generative models for artificial humans. [Python, PyTorch, ONNX, TensorRT, K8S]

Computer Scientist and Technical Lead, CASC, LLNL, Livermore, USA *Feb. 2017 – Sep. 2022*

- Technical lead for the development of MuMMI — a framework for massive autonomous multiscale simulations. Co-leading a cross-functional team of ML researchers, software engineers, and computational scientists (in biology and physics). Leading two massive HPC allocations (7,800,000 GPU hours on *Summit*) via the prestigious ALCC award. *[HPCwire, HPCwire, DEIXIS]*

- Developing, training, and deploying deep learning solutions for multimodal simulation data for cancer research. Utilizing computer vision, representation learning, metric learning, generative models, variational autoencoders, and graph neural networks. *[Nature Machine Intelligence, Machine Learning: Science & Technology]* [Python, TensorFlow, Keras, Horovod]

- Architected, developed, and leading an award-winning, open-source scalable scientific workflow to effectively utilize heterogenous HPC machines. *[Best Paper at SC 2019]* [Python, MPI, LSF, Slurm and Flux job schedulers, Bash, Redis, Spack].

- Developed a framework for a resolution-precision-adaptive representation and reduction of scientific data using a new tree datastructure, mixed-precision bytestreams, wavelet transforms, and streaming input. *[PacificVis 2022 Best Paper]* [C++17, VTK]

- Developed a software tool for analysis of simulated cell membranes realistically as surfaces. [Python, C++, SWIG, CGAL, VTK]

- Leading the R&D of *visual analytic tools* for performance analysis of HPC applications, using call profiles (CallFlow), and understanding GPU–CPU and GPU–GPU data movement. [Python, Numpy, Pandas, NetworkX, JavaScript, D3, Node, React]

Postdoctoral Researcher, CASC, LLNL, Livermore, USA *Dec. 2014 – Feb. 2017*

- Developed visualization and topological tools and techniques to analyze Li-ion battery simulations. [C++, OpenGL, Qt]

- Developed visual analytics tools to explore network traffic on supercomputers (TreeScope). [Python, Numpy, JavaScript, D3]

Lawrence Graduate Scholar, CASC, LLNL, Livermore, USA *Jan. 2012 – Nov. 2014*

- Developed a mathematical framework for visualization to remove boundary artifacts in a 160 y/o flow decomp. [Python]

- Developed computational tools for robust visualization & analysis of flows to lower comp. cost & improve data mgmt. [C++]

Research Intern, CASC, LLNL, Livermore, USA *Summer 2010 & 2011*

- Surveyed flow decompositions and their applications in science and engineering. Published a correction in a recent paper.

Research and Teaching Assistant, SCI Institute, The University of Utah, Salt Lake City, USA *Jan. 2009 – Jan. 2012*

- Developed award-winning combinatorial representations for robust analysis and visualization of 2D flow fields. [C++]

- Teaching assistant for graduate level courses. [Advanced Algorithms, Parallel Programming]

Software Engineer, Infosys Technologies Ltd., Bangalore, India   *Jul. 2007 – May. 2008*
- Developed software in object-oriented, multi-tier application environment.   [C, C++, Java, HTML, JSP, JavaScript, SAP]

HONORS & AWARDS

Best Paper Awards at International Conferences and Symposia

2022	**Best Paper Award** at IEEE Pacific Visualization Symposium	*Virtual, Japan*
2021	**Best Paper Honorable Mention** IEEE Symposium for Large-scale Data Analysis & Visualization	*Virtual, USA*
2019	**Best Paper Award** at ACM/IEEE Supercomputing Conference, SC'19	*Denver, USA*
2016	**Best Paper Award** at IEEE Pacific Visualization Symposium	*Taipei, Taiwan*
2011	**Best Paper Award** at IEEE Pacific Visualization Symposium	*Hong Kong*

Excellence in Publication and Outstanding Contribution Awards

2022	**PLS Directorate Award** for Excellence in Publication, LLNL	*Livermore, USA*
2020	**Deputy Director's Award** for Science & Technology Excellence in Publication, LLNL	*Livermore, USA*
2020	**Spot Award** for Outstanding contributions in Center for Applied Scientific Computing, LLNL	*Livermore, USA*
2019	**Deputy Director's Award** for Science & Technology Excellence in Publication, LLNL	*Livermore, USA*
2018	**Deputy Director's Award** for Science & Technology Excellence in Publication, LLNL	*Livermore, USA*
2018	**Spot Award** for Outstanding contributions in Center for Applied Scientific Computing, LLNL	*Livermore, USA*

Other Awards at National and International Levels

2014	**Invitation to participate** in the 2nd Heidelberg Laureate Forum (attendance by invitation only)	*Heidelberg, Germany*
2012	**4-year graduate fellowship** awarded by Livermore Graduate Scholar Program, LLNL	*Livermore, USA*
2007	**3rd prize** in the RedHat Challenge for technical-business idea (1st MIT, USA; 2nd 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 prize** 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*

PUBLICATIONS (ALSO SEE GOOGLE SCHOLAR)

JOURNAL ARTICLES

[44] **Harsh Bhatia**, F. Aydin, T. S. Carpenter, F. C. Lightstone, P.-T. Bremer, H. I. Ingólfsson, D. V. Nissley, and F. H. Streitz. The confluence of machine learning and multiscale simulations. *Current Opinions in Structural Biology*, 80, 2023. `doi:10.1016/j.sbi.2023.102569`.

[43] D. Hoang, **Harsh Bhatia**, P. Lindstrom, and P. Lindstrom. Progressive tree-based compression of large-scale particle data. *IEEE Trans. Vis. Comput. Graph.*, 2023. `doi:10.1109/TVCG.2023.3260628`.

[42] B. Zhu, M. Zhao, **Harsh Bhatia**, X. Xu, P.-T. Bremer, W. Meyer, N. Li, and T. Rognlien. Data-driven model for divertor plasma detachment prediction. *Journal of Plasma Physics*, 88(5):895880504, 2022. `doi:10.1017/S002237782200085X`.

[41] **Harsh Bhatia**, J. J. Thiagarajan, R. Anirudh, T. S. Jayram, T. Oppelstrup, H. I. Ingolfsson, F. C. Lightstone, and P.-T. Bremer. A biology-informed similarity metric for simulated patches of human cell membrane. *Machine Learning: Science and Technology*, 2022. To appear. `doi:10.1088/2632-2153/ac8523`.

[40] K. Nguyen, C. Lopez, C. Neale, Q. N. Van, T. Carpenter, F. Di Natale, T. Travers, T. Tran, A. Chan, **Harsh Bhatia**, P. H. Frank, M. Tonelli, X. Zhang, G. Gulten, T. Reddy, V. Burns, N. Hengartner, D. Simanshu, P.-T. Bremer, D. Chen, J. N. Glosli, R. Shreshta, T. Turbyville, F. H. Streitz, D. V. Nissley, H. I. Ingólfsson, A. G. Stephen, F. C. Lightstone, and S. Gnanakaran. Exploring CRD mobility during RAS/RAF engagement at the membrane. *Biophysical Journal*, 2022. To appear. `doi:10.1016/j.bpj.2022.06.035`.

[39] C. Lopez, X. Zhang, F. Aydin, R. Shrestha, Q. Van, C. Stanley, T. Carpenter, K. Nguyen, L. Patel, D. Chen, V. Burns, N. Hengartner, T. Reddy, **Harsh Bhatia**, F. Di Natale, T. Tran, A. Chan, D. Simanshu, D. Nissley, F. Streitz, A. Stephen, T. Turbyville, F. Lightstone, S. Gnanakaran, H. Ingólfsson, and C. Neale. Asynchronous reciprocal coupling of MARTINI 2.2 coarse-grained and CHARMM36 all-atom simulations in an automated multiscale framework. *Journal of Chemical Theory and Computation*, 18(8):5025–5045, 2022. `doi:10.1021/acs.jctc.2c00168`.

[38] **Harsh Bhatia**, D. Hoang, N. Morrical, V. Pascucci, P.-T. Bremer, and P. Lindstrom. AMM: Adaptive multilinear meshes. *IEEE Trans. Vis. Comput. Graph.*, 28(6):2350–2363, 2022. `doi:10.1109/TVCG.2022.3165392`.   *[Best Paper Award]*

[37] H. I. Ingólfsson, C. Neale, T. Carpenter, R. Shrestha, C. Lopez, T. Tran, T. Oppelstrup, **Harsh Bhatia**, L. Stanton, X. Zhang, S. Sundram, F. Di Natale, A. Agarwal, G. Dharuman, S. Kokkila Schumacher, T. Turbyville, G. Gulten, Q. Van, D. Goswami, F. Jean-Francios, C. Agamasu, D. Chen, J. Hettige, T. Travers, S. Sarkar, M. Surh, Y. Yang, A. Moody, S. Liu, B. V. Essen, A. Voter, A. Ramanathan, N. Hengartner, D. Simanshu, A. Stephen, P.-T. Bremer, S. Gnanakaran, J. Glosli, F. Lightstone, F. McCormick, D. Nissley, and F. Streitz. Machine learning-driven multiscale modeling reveals lipid-dependent dynamics of ras signaling protein. *Proceedings of National Academy of Sciences (PNAS)*, 2021. `doi:10.1073/pnas.2113297119`.

[36] S. Kesavan, **Harsh Bhatia**, A. Bhatele, S. Brink, O. Pearce, T. Gamblin, P.-T. Bremer, and K.-L. Ma. Scalable comparative visualization of ensembles of call graphs. *IEEE Trans. Vis. Comput. Graph.*, 2021. Preprint. `doi:10.1109/TVCG.2021.3129414`.

[35] **Harsh Bhatia**, R. M. Kirby, V. Pascucci, and P.-T. Bremer. Vector field decompositions using multiscale poisson kernel. *IEEE Trans. Vis. Comput. Graph.*, 27(9):3781–3793, Sep 2021. `doi:10.1109/TVCG.2020.2984413`.

[34] T. McDonald, R. Shrestha, X. Yi, **Harsh Bhatia**, D. Chen, D. Goswami, V. Pascucci, T. Turbyville, and P.-T. Bremer. Leveraging topological events in tracking graphs for understanding particle diffusion. *Comput. Graph. Forum*, 40(3):251–262, Jun 2021. `doi:10.1111/cgf.14304`.

[33] **Harsh Bhatia**, T. S. Carpenter, H. I. Ingólfsson, G. Dharuman, P. Karande, S. Liu, T. Oppelstrup, C. Neale, F. C. Lightstone, B. Van Essen, J. N. Glosli, and P.-T. Bremer. Machine-learning-based dynamic-importance sampling for adaptive multiscale simulations. *Nature Mach. Intell.*, 3:401–409, Apr 2021. `doi:10.1038/s42256-021-00327-w`.

[32] H. T. P. Nguyen, A. Bhatele, N. Jain, S. Kesavan, **Harsh Bhatia**, T. Gamblin, K.-L. Ma, and P.-T. Bremer. Visualizing hierarchical performance profiles of parallel codes using callflow. *IEEE Trans. Vis. Comput. Graph.*, 27(4):2455–2468, Apr 2021. `doi:10.1109/TVCG.2019.2953746`.

[31] D. Hoang, B. Summa, **Harsh Bhatia**, P. Lindstrom, P. Klacansky, W. Usher, P.-T. Bremer, and V. Pascucci. Efficient and flexible hierarchical data layouts for a unified encoding of scalar field precision and resolution. *IEEE Trans. Vis. Comput. Graph.*, 27(2):603–613, Feb 2021. `doi:10.1109/TVCG.2020.3030381`.

[30] H. I. Ingólfsson, T. S. Carpenter, **Harsh Bhatia**, P.-T. Bremer, S. J. Marrink, and F. C. Lightstone. Capturing biologically complex tissue-specific membranes at different kevels of compositional complexity. *The Journal of Physical Chemistry B: Biophysics, Biomaterials, Liquids, Soft Matter*, 124(36):7819–7829, Aug 2020. `doi:10.1021/acs.jpcb.0c03368`.

[29] S. Liu, D. Wang, D. Maljovec, R. Anirudh, J. J. Thiagarajan, S. A. Jacobs, B. C. Van Essen, D. Hysom, J. Yeom, J. Gaffney, L. Peterson, P. B. Robinson, **Harsh Bhatia**, V. Pascucci, B. K. Spears, and P. Bremer. Scalable topological data analysis and visualization for evaluating data-driven models in scientific applications. *IEEE Trans. Vis. Comput. Graph.*, 26(1):291–300, Jan 2020. `doi:10.1109/TVCG.2019.2934594`.

[28] **Harsh Bhatia**, H. I. Ingólfsson, T. S. Carpenter, F. C. Lightstone, and P.-T. Bremer. Memsurfer: A tool for robust computation and characterization of curved membranes. *Journal of Chemical Theory and Computation*, 15(11):6411–6421, Nov 2019. `doi:10.1021/acs.jctc.9b00453`.   *[Journal Cover]*

[27] 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.*, 25(1):1193–1203, Jan 2019. `doi:10.1109/TVCG.2018.2864853`.

[26] **Harsh Bhatia**, N. Jain, A. Bhatele, 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`.

[25] **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`.

[24] 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, Nov 2017. `doi:10.1016/j.bpj.2017.10.017`.   *[Journal Cover]*

[23] 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, Mar 2017. `doi:10.1021/acs.jpcc.7b02006`.

[22] **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`.

[21] 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]*

[20] **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`.

[19] **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`.

[18] **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`.

[17] **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]*

[16] 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`.

[15] **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`.

[14] **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`.

[13] 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

[12] **Harsh Bhatia**, S. N. Petruzza, R. Anirudh, A. G. Gyulassy, R. M. Kirby, V. Pascucci, and P.-T. Bremer. Data-driven estimation of temporal-sampling errors in unsteady flows. In *Advances in Visual Computing*, ISVC '21. Springer, Oct 2021.

[11] D. Hoang, **Harsh Bhatia**, P. Lindstrom, and V. Pascucci. High-quality and low-memory-footprint progressive decoding of large-scale particle data. In *IEEE Symposium on Large-Scale Data Analysis and Visualization*, LDAV '21, Oct 2021. *[Best Paper Honorable Mention]*

[10] **Harsh Bhatia**, F. Di Natale, J. Y. Moon, X. Zhang, J. R. Chavez, F. Aydin, C. Stanley, T. Oppelstrup, C. Neale, S. K. Schumacher, D. Ahn, S. Herbein, T. S. Carpenter, S. Gnanakaran, P.-T. Bremer, J. N. Glosli, F. C. Lightstone, and H. I. Ingólfsson. Generalizable coordination of large multiscale ensembles: Challenges and learnings at scale. In *Proceedings of the International Conference for High Performance Computing, Networking, Storage and Analysis*, SC '21, New York, NY, USA, Nov 2021. ACM. `doi:10.1145/3458817.3476210`.

[9] F. Di Natale, **Harsh Bhatia**, T. S. Carpenter, C. Neale, S. K. Schumacher, T. Oppelstrup, L. Stanton, X. Zhang, S. Sundram, T. R. W. Scogland, G. Dharuman, M. P. Surh, Y. Yang, C. Misale, L. Schneidenbach, C. Costa, C. Kim, B. D'Amora, S. Gnanakaran, D. V. Nissley, F. Streitz, F. C. Lightstone, P.-T. Bremer, J. N. Glosli, and H. I. Ingólfsson. A massively parallel infrastructure for adaptive multiscale simulations: Modeling ras initiation pathway for cancer. In *Proceedings of the International Conference for High Performance Computing, Networking, Storage and Analysis*, SC '19, New York, NY, USA, Nov 2019. ACM. `doi:10.1145/3295500.3356197`. *[Best Paper Award]*

[8] T. Patki, Z. Frye, **Harsh Bhatia**, F. Di Natale, J. Glosli, H. I. Ingólfsson, and B. Rountree. Comparing gpu power and frequency capping: A case study with the mummi workflow. In *Proc. of the 14th Workshop on Workflows in Support of Large-Scale Science (WORKS19)*, pages 31–39, Nov. 2019. `doi:10.1109/WORKS49585.2019.00009`.

[7] B. Wang, R. Bujack, P. Rosen, P. Skraba, **Harsh Bhatia**, and H. Hagen. Interpreting Galilean invariant vector field analysis via extended robustness. In C. H., F. I., S. F., and T. S., editors, *Topological Methods in Data Analysis and Visualization V (TopoInVis 2017)*, Mathematics and Visualization, pages 221–235. Springer, Cham, 2020. `doi:10.1007/978-3-030-43036-8_14`.

[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`.

[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`.

[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`.

[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`.

[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]*

[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

[Ph.D.] **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`.

[B.Tech.] **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.