

Curriculum Vitae

Sathish S. Vadhiyar

Associate Professor

Department of Computational and Data Sciences (DCDS) (erstwhile SERC¹)

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Research Interests

- **HPC Runtime Systems / Application Frameworks:** Our lab works on building runtime systems for HPC applications on both accelerator and general HPC systems. We primarily focus on irregular applications including graph applications, N-Body simulations, Molecular Dynamics (MD), and Adaptive Mesh Refinement (AMR) applications. We have also worked with applications in climate science and visualization in collaboration with researchers working in these areas.
 - Accelerator systems: Techniques for load balancing, hybrid executions utilizing both CPU and GPU cores, and efficient executions of different programming models on these systems.
 - Large-scale systems: Scalability studies, tools and techniques, processor allocation, mapping and remapping strategies on HPC network topologies.
- **Middleware:**
 - Job Scheduling: Our work is on analyzing job submissions, developing prediction strategies and scheduling techniques that use predictions for efficient job management and utilization of production supercomputer systems.
 - Fault Tolerance: For exascale applications using checkpointing and process replication.

Besides these, we are also eager to learn about and providing solutions for efficient executions, good speedups, and in general remarkable reduction in turnaround times of large time-consuming Industrial applications.

Education

- **Ph.D:** May 2003, Department of Computer Science, University of Tennessee, U.S.A.
Dissertation: *A Preemption-Based Meta-Scheduling System for Distributed Computing*
Advisor: Dr. Jack Dongarra

¹The supercomputing facilities and academics of erstwhile SERC (Supercomputer Education and Research Centre) were demarcated into a facility unit, continued to be called as SERC, and an academic unit, now called as DCDS.

- **M.S.:** May 1999, Department of Computer Science, Clemson University, South Carolina, U.S.A.
Project: *Static Assignment of Multithreaded Systems*
Advisor: Dr. Harold Grossman
- **B.E.:** May 1997, Computer Science and Engineering, Thiagarajar College of Engineering, Madurai, India
Project: *Anti-missile simulation software based on neural networks*

Experience

- **December 2015 - present:** Associate Professor, Department of Computational and Data Sciences (erstwhile SERC²), Indian Institute of Science, Bangalore, India.
- **November 2009 - December 2015:** Associate Professor, Supercomputer Education and Research Centre, Indian Institute of Science, Bangalore, India.
- **June 2013:** JT Oden Faculty Fellow Lab of Prof. Keshav Pingali, The Institute for Computational and Engineering Sciences (ICES), University of Texas, Austin, USA
- **July - August 2010:** Visitor, Parallel Programming Lab (Lab of Prof. Laxmikant Kale), Computer Science Department, University of Illinois, Urbana-Champaign, USA
- **November 2003 - present:** Assistant Professor, Supercomputer Education and Research Centre, Indian Institute of Science, Bangalore, India.
- **May 2003 - August 2003:** Senior Research Associate, Innovative Computing Laboratory, Department of Computer Science, Knoxville, Tennessee, U.S.A.
- **May 1999 - May 2003:** Graduate Research Assistant, Innovative Computing Laboratory, Department of Computer Science, Knoxville, Tennessee, U.S.A.

Publications

Papers in Refereed Journals

1. Cijo George, Sathish Vadhiyar. Fault Tolerance on Large Scale Systems using Adaptive Process Replication. *IEEE Transactions on Computers*, Vol 64/8, pp 2213-2225, August 2015.
2. Hari Raghavan, Sathish Vadhiyar. Adaptive Executions of Hyperbolic Block-Structured AMR Applications on GPU Systems. *International Journal of High Performance Computing Applications (IJHPCA)*, Vol 29/2, pp 135-153, 2015.
3. Hari Raghavan, Sathish Vadhiyar. Efficient Asynchronous Executions of AMR Computations and Visualization on a GPU System. *Journal of Parallel and Distributed Computing (JPDC)*, Vol 73/6, pp 866-875, 2013.
4. Sivagama Sundari M., Sathish Vadhiyar, Ravi Nanjundiah. Large Improvements in Application Throughput of Long-running Multi-Component Applications using Batch Grids. *Concurrency and Computation: Practice & Experience*, Vol 24/15, pp 1775-1791, 2012.

²The supercomputing facilities and academics of erstwhile SERC were demarcated into a facility unit, continued to be called as SERC, and an academic unit, now called as DCDS.

5. Sivagama Sundari M., Sathish Vadhiyar, Ravi Nanjundiah. Adaptive Executions of Multi-Physics Coupled Applications on Grids. *Journal of Grid Computing*, Vol 9/4, pp 455-478, 2011.
6. H.A. Sanjay and Sathish Vadhiyar. Strategies for Rescheduling Tightly-Coupled Parallel Applications in Multi-Cluster Grids. *Journal of Grid Computing*, Vol 9/3, pp 379-403, 2011.
7. Sivagama Sundari M., Sathish Vadhiyar, Ravi Nanjundiah. Grids with Multiple Batch Systems for Performance Enhancement of Multi-Component and Parameter Sweep Parallel Applications. *Future Generation Computer Systems*, Vol 26/2, pp 217-227, 2010.
8. H.A. Sanjay and Sathish Vadhiyar. A Strategy for Scheduling Tightly-Coupled Parallel Applications on Clusters. *Concurrency and Computation: Practice & Experience*, Vol 21/18, pp 2491-2517, 2009.
9. Sivagama Sundari M., Sathish Vadhiyar, Ravi Nanjundiah. Dynamic Component Extension: a Strategy for Performance Improvement in Multicomponent Applications. *International Journal of High Performance Computing Applications*, Vol 23/1 pp 84-98, 2009.
10. Yadnyesh Joshi and Sathish Vadhiyar. Analysis of DNA Sequence Transformations on Grids. *Journal of Parallel and Distributed Computing*, Vol 69/1, pp 80-90, 2009.
11. H.A. Sanjay and Sathish Vadhiyar. Performance Modeling of Parallel Applications for Grid Scheduling. *Journal of Parallel and Distributed Computing*, vol 68/8 pp 1135-1145, 2008.
12. Sandip Tikar and Sathish Vadhiyar. Efficient Reuse of Replicated Parallel Data Segments in Computational Grids. *Future Generation Computer Systems*, vol 24/7 pp 644-657, 2008.
13. J. Dongarra, G. Bosilca, Z. Chen, V. Eijkhout, G. Fagg, E. Fuentes, J. Langou, P. Luszczek, J. Pjesivac-Grbovic, K. Seymour, H. You, and Sathish Vadhiyar. Self-adapting Numerical Software (SANS) Effort. *IBM Journal of System Research and Development. Exploratory Systems Research*, volume 50, Number 2/3, pp. 223-238, 2006.
14. Sathish Vadhiyar and J. Dongarra. Self adaptivity in Grid computing. *Concurrency and Computation: Practice and Experience*, volume 17, Issue 2-4, pp. 235-257, Special Issue: Grid Performance . Issue Edited by John Gurd, Tony Hey, Juri Papay, Graham Riley. Copyright ©. John Wiley & Sons, Ltd. Feb 7, 2005.
15. Sathish Vadhiyar and Jack Dongarra. GrADSolve - A Grid-based RPC system for Parallel Computing with Application-level Scheduling. *Journal of Parallel and Distributed Computing*, volume 64, pp. 774-783, 2004.
16. Sathish Vadhiyar, Graham Fagg and Jack Dongarra. Toward an Accurate Model for Collective Communications. *International Journal of High Performance Computing Applications*, volume 18, Number 1, Spring 2004, pp 159-166, ISSN 1094-3420.
17. Sathish Vadhiyar and Jack Dongarra. SRS - A Framework for Developing Malleable and Migratable Parallel Applications for Distributed Systems. *Parallel Processing Letters*, vol. 13, number 2, pp. 291-312, June 2003.
18. M. Beck and D. Arnold and A. Bassi and F. Berman and H. Casanova and J. Dongarra and T. Moore and G. Obertelli and J. Plank and M. Swany and S. Vadhiyar and R. Wolski. Middleware for the use of Storage in Communication. *Parallel Computing*, Volume 28 , Issue 12, pages 1773 - 1787, 2002.

19. A. Petitet, S. Blackford, J. Dongarra, B. Ellis, G. Fagg, K. Roche and Sathish Vadhiyar. Numerical Libraries and The Grid: The GrADS Experiments with ScaLAPACK. *Journal of High Performance Applications and Supercomputing*, Vol. 15, number 4, pp. 359-374, Winter 2001.

Papers at Refereed Conferences and Workshops

20. Prakash Murali, Sathish Vadhiyar. Metascheduling of HPC Jobs in Day-Ahead Electricity Markets. In the Proceedings of the *International Conference on High Performance Computing (HiPC)*, December 2015, Bangalore, India.
21. Anirudh Jayakumar, Prakash Murali, Sathish Vadhiyar. Matching Application Signatures for Performance Predictions using a Single Execution. In the Proceedings of the *IEEE International Parallel and Distributed Processing Symposium (IPDPS)* 2015, Hyderabad, India.
22. Rajath Kumar, Sathish Vadhiyar. Prediction of Queue Waiting Times for Metascheduling on Parallel Batch Systems. In the proceedings of the *Workshop on Job Scheduling Strategies for Parallel Processing (JSSPP)*, May 2014, Phoenix, USA, appeared in Lecture Notes in Computer Science (LNCS), Volume 8828, pages 108-128, 2015.
23. Anurag Murty, Vijay Natarajan, Sathish Vadhiyar. Efficient Homology Computations on Multicore and Manycore Systems. In the proceedings of the *International Conference on High Performance Computing (HiPC)*, December 2013, Bangalore, India.
24. Sai Kiran Korwar, Sathish Vadhiyar, Ravi Nanjundiah. GPU-enabled Efficient Executions of Radiation Calculations in Climate Modeling. In the proceedings of the *International Conference on High Performance Computing (HiPC)*, December 2013, Bangalore, India.
25. Preeti Malakar, Vijay Natarajan, Sathish Vadhiyar, Ravi Nanjundiah. A Diffusion-Based Processor Reallocation Strategy for Tracking Multiple Dynamically Varying Weather Phenomena. In the proceedings of the *International Conference on Parallel Processing (ICPP)*, October 2013, Lyon, France.
26. R. Vasudevan, Sathish Vadhiyar, Laxmikant Kale. G-Charm: An Adaptive Runtime System for Message-Driven Parallel Applications on Hybrid Systems. In the proceedings of *International Conference on Supercomputing (ICS)*, pp 349-358, June 2013, Eugene, Oregon, USA.
27. Preeti Malakar, Thomas George, Sameer Kumar, Rashmi Mittal, Vijay Natarajan, Yogish Sabharwal, Vaibhav Saxena, Sathish Vadhiyar. A Divide and Conquer Strategy for Scaling Weather Simulations with Multiple Regions of Interest. In the proceedings of *IEEE/ACM Supercomputing conference, SC 2012*, November 2012, Salt Lake City, Utah, USA. **Best student paper nominee.**
28. Cijo George, Sathish Vadhiyar. AdFT:An Adaptive Framework for Fault Tolerance on Large Scale Systems using Application Malleability. In the proceedings of *International Conference on Computational Science (ICCS)*, June 2012, Omaha, Nebraska, USA, pp 166-175.
29. Rajath Kumar, Sathish Vadhiyar. Identifying Quick Starters: Towards an Integrated Framework for Efficient Predictions of Queue Waiting Times of Batch Parallel Jobs. In the Workshop on *Job Scheduling Strategies for Parallel Processing (JSSPP)*, May 2012, Shanghai, China.

30. Preeti Malakar, Vijay Natarajan, Sathish Vadhiyar. InSt: An Integrated Steering Framework for Critical Weather Applications. In the proceedings of *International Conference on Computational Science (ICCS)*, June 2011, Singapore, pp 116-125.
31. Preeti Malakar, Vijay Natarajan, Sathish Vadhiyar. An Adaptive Framework for Simulation and Online Remote Visualization of Critical Climate Applications in Resource-constrained Environments. In the proceedings of *IEEE/ACM Supercomputing conference, SC 2010*, November 2010, New Orleans, USA.
32. Priyank Raj Khatariya and Sathish Vadhiyar. Phylogenetic Predictions on Grids. In *Proceedings of the 5th IEEE International Conference of e-Science*, Oxford, UK, December 2009.
33. Rakhi Gupta and Sathish Vadhiyar. An Efficient MPI_Allgather for Grids. In *proceedings of High Performance Distributed Computing (HPDC)*, pp 169-178, Monterey, California, USA, June 2007.
34. Jay Yagnik, H. A. Sanjay and Sathish Vadhiyar. Performance Modeling based on Multidimensional Surface Learning for Performance Predictions of Parallel Applications in Non-Dedicated Environments. In *proceedings of 35th International Conference on Parallel Processing (ICPP)*, pp 513-520, Columbus, Ohio, USA, August 2006.
35. Rakhi Gupta and Sathish Vadhiyar. Application-Oriented Adaptive MPI_Bcast for Grids. In *proceedings of 20th IEEE International Parallel & Distributed Processing Symposium (IPDPS)*, Rhodes Island, Greece, April 2006.
36. Sathish Vadhiyar, Jack Dongarra and Asim Yarkhan. GrADSolve - RPC for High Performance Computing on the Grid. *Euro-Par 2003, 9th International Euro-Par Conference*, Proceedings, Springer, LCNS 2790, p. 394-403, August 26 -29, 2003.
37. Sathish Vadhiyar and Jack Dongarra. A Performance Oriented Migration Framework for the Grid. *Proceedings of The 3rd IEEE/ACM International Symposium on Cluster Computing and the Grid (CCGrid 2003)*, pp 130-137, Tokyo, Japan, May 2003.
38. Sathish Vadhiyar and Jack Dongarra. A Metascheduler for the Grid. *Proceedings of the 11th IEEE International Symposium on High Performance Distributed Computing*, pp 343-351, Edinburgh, Scotland, July, 2002.
39. K. Kennedy, M. Mazina, J. Mellor-Crummey, K. Cooper, L. Torczon, F. Berman, A. Chien, H. Dail, O. Sievert, D. Angulo, I. Foster, D. Gannon, L. Johnsson, K. Kasselmann, R. Aydt, D. Reed, J. Dongarra, Sathish Vadhiyar and R. Wolski. Toward a Framework for Preparing and Executing Adaptive Grid Programs. *Proceedings of NSF Next Generation Systems Program Workshop (International Parallel and Distributed Processing Symposium 2002)*, Fort Lauderdale, Florida, USA, 2002.
40. A. Petitet, S. Blackford, J. Dongarra, B. Ellis, G. Fagg, K. Roche and S. Vadhiyar. Numerical Libraries and The Grid: The GrADS Experiments with ScaLAPACK. *Proceedings of Supercomputing 2001 (SC)*, Denver, Colorado, 2001.
41. Sathish Vadhiyar, G. Fagg and J. Dongarra. Performance Modeling For Self Adapting Collective Communications for MPI. *Proceedings of Los Alamos Computer Science Institute (LACSI) Symposium*, Santa Fe, USA, October 2001.
42. M. Beck, D. Arnold, A. Bassi, F. Berman, H. Casanova, J. Dongarra, T. Moore, G. Obertelli, J. Plank, M. Swany, Sathish Vadhiyar, R. Wolski. Logistical Computing and Internet-working: Middleware for the Use of Storage in Communication. *Third Annual International Workshop on Active Middleware Services (AMS)*, San Francisco, CA, August, 2001.

43. Sathish Vadhiyar, Graham Fagg and Jack Dongarra. Towards an Accurate Model for Collective Communications. *In Proceedings of International Conference on Computational Science - ICCS 2001*, San Francisco, CA. Lecture Notes in Computer Science, Vol. 2073 (Berlin: Springer Verlag), pp 41-50, 2001.
44. Graham Fagg, Sathish Vadhiyar and Jack Dongarra. ACCT: Automatic Collective Communications Tuning. *Proceedings of the 7th European PVM/MPI Users' Group Meeting on Recent Advances in Parallel Virtual Machine and Message Passing Interface*, pages 354-362, Hungary, 2000.
45. Sathish Vadhiyar, Graham Fagg and Jack Dongarra. Automatically Tuned Collective Communications. *Proceedings of Supercomputing 2000*, Dallas, Texas, 2000.
46. Sathish Vadhiyar and Harold Grossman. Static Assignment of Multithreaded Systems. *ACM Southeast Regional Conference 1999*.

Book Chapters

47. H. Dail, O. Sievert, F. Berman, H. Casanova, A. YarKhan, Sathish Vadhiyar, J. Dongarra, C. Liu, L. Yang, D. Angulo, I. Foster. Scheduling in the Grid Application Development Software Project. *in Grid Resource Management: State of the art and future trends, Edited by Jarek Nabrzyski, Jennifer Schopf and Jan Weglarz, Kluwer Academic Publisher, 2003, ISBN 1-4020-7575-8*.
48. Sudesh Agrawal, Jack Dongarra, Keith Seymour, and Sathish Vadhiyar. NetSolve: Past, Present, and Future - a Look at a Grid Enabled Server. *in Grid Computing: Making the Global Infrastructure a Reality, Edited by F. Berman, G. Fox, and A. Hey, Wiley Publisher, 2003, ISBN 0-470-85319-0*.

Technical Reports

49. Sathish Vadhiyar, Graham Fagg and Jack Dongarra. Toward an Accurate Model for Collective Communications. *Computer Science Department, University of Tennessee, ut-cs-05-550*, 2005.
50. Typically a team of 8-10 including S Vadhiyar. User's guide to NetSolve, versions 1,1.4,1.4.1,2.0. Computer Science Department, University of Tennessee, Technical Reports.
51. Sathish Vadhiyar. A Preemption-Based Meta-Scheduling System for Distributed Computing. *Ph.D Dissertation, Computer Science, University of Tennessee*, 2003.

Refereed Conference Short Papers and Posters

52. Rajath Prasad, Sathish Vadhiyar. Scheduling Strategies for Multi-Physics Applications. *Student Research Symposium poster, International Conference on High Performance Computing (HiPC)*, Bangalore, India, 2011.
53. Archana Venkatesh, Sathish Vadhiyar. Asynchronous Parallelism for Molecular Dynamics on GPU cores. *Student Research Symposium poster, International Conference on High Performance Computing (HiPC)*, Bangalore, India, 2011.
54. Rajath Prasad, Sathish Vadhiyar. Scheduling Strategies for Multi-Physics Applications. *Poster. IBM I-CARE*, 2011.

55. Archana Venkatesh, Sathish Vadhiyar. Asynchronous Parallelism for Molecular Dynamics on GPU cores. *Poster. IBM I-CARE*, 2011.
56. Sivagama Sundari M., Sathish Vadhiyar, Ravi Nanjundiah. Morco: Middleware Framework for Long-running Multi-component Applications on Batch Grids. Short paper. In the proceedings of the *ACM High Performance Distributed Computing (HPDC)*, pp 328-331, June 2010, Chicago, USA.
57. Preeti Malakar, Vijay Natarajan, Sathish Vadhiyar and Ravi Nanjundiah. An Integrated Simulation and Visualization Framework for Tracking Cyclone Aila. *Student Research Symposium poster, International Conference on High Performance Computing (HiPC)*, Kochi, India, 2009. **Best Paper Award.**
58. Sivagama Sundari M., Sathish Vadhiyar and Ravi Nanjundiah. Middleware for Long-Running Applications on Batch Grids. *Student Research Symposium poster, International Conference on High Performance Computing (HiPC)*, Kochi, India, 2009.
59. Preeti Malakar, Vijay Natarajan, Sathish Vadhiyar and Ravi Nanjundiah. An Integrated Simulation and Visualization Framework for Tracking Cyclone Aila. *Student poster in ATIP First Workshop on HPC in India: Indigenous Hardware, Software, and Infrastructure Research*, held in conjunction with IEEE/ACM Supercomputing (SC), Portland, Oregon, USA, 2009.
60. Sivagama Sundari M., Sathish Vadhiyar and Ravi Nanjundiah. Middleware for Long-running Applications on Batch Grids. *Student poster in ATIP First Workshop on HPC in India: Indigenous Hardware, Software, and Infrastructure Research*, held in conjunction with IEEE/ACM Supercomputing (SC), Portland, Oregon, USA, 2009.
61. Sivagama Sundari M., Sathish Vadhiyar and Ravi Nanjundiah. Executing Long-running Multi-component Applications on Batch Grids. *Student Research Symposium poster, International Conference on High Performance Computing (HiPC)*, Bangalore, India, 2008.
62. H. A. Sanjay and Sathish Vadhiyar. Performance Modeling Based Scheduling and Rescheduling of Parallel Applications on Computational Grids. *International Conference on High Performance Computing (HiPC)*, Goa, India, 2007.
63. Sivagama Sundari M., Sathish Vadhiyar and Ravi Nanjundiah. Coupled Climate Models on Grids. *International Conference on High Performance Computing (HiPC)*, Goa, India, 2007.

Invited Talks

1. Metascheduling of HPC Jobs in Day-Ahead Electricity Markets. Jawaharlal Nehru University (JNU), Delhi, November 2015.
2. Optimization Strategies for GPU Computing. National Institute of Technology (NIT), Trichy, India. January 2015.
3. Hybrid Executions. Keynote Talk, Nitte Meenakshi Institute of Technology (NMIT), Bangalore, India. August 2014.
4. Parallel Programming Basics and Areas for Research Projects. Tutorial, Indo-Sys Workshop, Bangalore India. June 2014.
5. Outreach talks for the department: RVCE, MSRIT, BMSCE, 2014.

6. GPU Enabled Efficient Executions of Radiation Calculations in Climate Modeling. NVIDIA Professors' Meet, Bangalore, India. December 2013.
7. Fault Tolerance for Exascale Systems using Adaptive Process Replication. US-India workshop on High Performance Computing, Systems and Applications, Supercomputer Education and Research Centre, Indian Institute of Science, Bangalore, India. December 2013.
8. Partitioning and Repartitioning Strategies for Weather Applications on Torus Systems. Garuda-NKN Partners Meet, Bangalore, India. July 2013.
9. Overview of Research in GARL. Prof. Pingali's group, The Institute for Computational Engineering and Sciences (ICES), University of Texas, Austin, USA, June 2013.
10. Grid Middleware Research for Parallel Computing. BMSIT, Bangalore, India. March 2013.
11. 3 Parallel Programming Models - MPI, OpenMP, CUDA. MS Ramiah Institute of Technology (MSRIT), Bangalore, India. March 2013.
12. Middleware Research in Parallel Computing. Workshop in Computational Science (WCP). Supercomputer Education and Research Centre, Indian Institute of Science, Bangalore, India. February 2013.
13. Research in Parallel Computing. Workshop in Computational Science (WCP). Supercomputer Education and Research Centre, Indian Institute of Science, Bangalore, India. February 2012.
14. A Comprehensive Framework for Real Time Visualization and Steering of Critical Weather Applications. Garuda-NKN Partners Meet. July 2011.
15. Research in Parallel Computing. Workshop in Computational Science (WCP). Supercomputer Education and Research Centre, Indian Institute of Science, Bangalore, India. February 2011.
16. Tracking and Steering Critical Weather Events on Garuda. CDAC Round-Table Meeting on Weather and Climate Modeling, Centre for Development of Advanced Computing (CDAC), Bangalore, India. February 2011.
17. Middleware Frameworks for Adaptive Executions and Visualizations of Climate and Weather Applications on Grids. Hadoop India Summit, Indian Institute of Science, Bangalore, India. February 2011.
18. Scheduling and Rescheduling in Grid. Workshop on Grid Computing, Madras Institute of Technology (MIT), Chennai, India. February 2011.
19. Coupled Climate Models on Grids. EU-India Grid2 Workshop on Climate Change, Indian Institute of Technology (IIT) Delhi, India. December 2010.
20. Middleware Framework for Online Remote Visualization of Cyclone Events using Garuda. *5th CDAC Garuda Partners Meet*, Bangalore, India. May 2010.
21. Middleware Frameworks for Climate Simulations on Multiple Parallel Systems, *IBM Software Lab, Bangalore, India*. April 2010.
22. Biology on Clouds and Climate Science on Grids, *Yahoo! India, Bangalore, India*. February 2010.

23. Grid Middleware for High Performance Computing, *Indian National Academy of Engineering (INAE) Annual Convention, Kalpakkam, India*. December 2009.
24. Grid Middleware for High Performance Computing, *ATIP First Workshop on HPC in India: Indigenous Hardware, Software, and Infrastructure Research, held in conjunction with IEEE/ACM Supercomputing (SC) conference, Portland, Oregon, USA*. November 2009.
25. Top Supercomputers-India, *Centre for Development of Advanced Computing (CDAC), Bangalore, India*. October 2009.
26. Top Supercomputers-India, *International Conference on High Performance Computing (HiPC), Bangalore, India*. December 2008.
27. Towards Uniform Map-Reduce Communications. *Yahoo!, Bangalore, India*. October 2008.
28. High Performance Computing in Grids. *Computational Research Lab (CRL) Ltd., Pune, India*. March 2008.
29. Grid Scheduling, Rescheduling and Applications for Garuda. *Third Garuda Partners Meet, Bangalore, India*. March 2008.
30. Performance Modeling of Parallel Applications for Grids. *Wipro Technologies, Bangalore, India*. January 2008.
31. GrADSolve: A Performance Oriented Grid System & Grid Activities in GARL. *Supercomputer Education and Research Centre (SERC), Indian Institute of Science (IISc), Bangalore, India*. April 2005.
32. GrADSolve Resource Management System and Grid Research Activities in SERC, IISc. *Tata Institute of Fundamental Research (TIFR), Mumbai, India*. January 2005.
33. Self Adaptive Scientific Applications in Computational Grids. *IBM, Bangalore, India*. November 2004.
34. GrADSolve - Grid Resource Management System. *Centre for Development of Advanced Computing (CDAC), Bangalore, India*. August 2004.
35. Rescheduling, Redistribution and Towards Dynamic Tuning of Grid Policies. *Indo-UK eScience Workshop, IIT, Delhi, India*. February 2004.
36. Application-Level Scheduling and Metascheduling for the Grid. *Indo-UK eScience Workshop, IIT, Delhi, India*. February 2004.
37. GrADSolve - Grid Resource Management System. *Tata Institute of Fundamental Research (TIFR), Indian Institute of Science (IISc), Bangalore, India*. February 2004.

Invited Lectures

1. HPC and Parallel Computing. *Centre for Development of Advanced Computing (CDAC), Bangalore, India*. January 2011.
2. Parallel and Distributed Computing. *Workshop on Large Scale Computing for SAP Research Group, Bangalore in Indian Institute of Science, India*. September 2010.

3. Grid Computing. Lecture. *Vellore Institute of Technology, India*. July 2009.
4. Parallel Programming. Lecture. *Vellore Institute of Technology, India*. July 2009.
5. Writing Parallel Programs. Lecture. *Supercomputer Education and Research Centre (SERC), Indian Institute of Science (IISc), Bangalore, India*. February 2009.
6. Parallel Programming for Distributed Memory Machines. Lecture. *Atria Institute of Technology, Bangalore, India*. August 2007.

Sponsored Projects

- Rs. 44,67,554 (US \$70,915). Co-Investigator. Intel Parallel Computing Centre (IPCC) for Modeling Monsoons and Tropical Climate. June 2014 - June 2015.
- Rs. 10,17,500 (US \$15,650). Centre for Development of Advanced Computing (CDAC). June 2013 - March 2014. *A Framework for Efficient Executions of Irregular Applications on Hybrid Systems*.
- A Kepler Card. NVIDIA CUDA Research Centre (CRC). January - December 2013.
- Rs. 28,36,800 (US \$43,650). Department of Science and Technology. December 2012 - December 2015. *A Robust Middleware for Job management in Supercomputer systems*.
- Rs. 13,90,500 (US \$24500). Centre for Development of Advanced Computing (CDAC). August 2010 - March 2012. With Dr. Vijay Natarajan, CSA, IISc and Prof. Ravi Nanjundiah, CAOS, IISc. *Middleware for Online Remote Visualization of Weather Applications*.
- Rs. 5,56,500 (US \$13000). European Commission. October 2010 - September 2011. With Prof. Ravi Nanjundiah, CAOS, IISc. *Sustainable e-infrastructures across Europe and India*.
- Rs. 2,25,000 (US \$2000). Yahoo! India. Consultancy project. May 2008 - July 2008. *Exploration of Research Challenges and Methods in Yahoo!'s Hadoop Infrastructure*.
- Rs. 38,30,000 (US \$76,600). Ministry of Information Technology. May 2007 - May 2010. With Prof. Ravi Nanjundiah, CAOS, IISc. *Coupled climate models on grids*.
- Rs. 22,28,400 (US \$44,568). Department of Science and Technology. July 2006 - Jan. 2010. *A Checkpointing infrastructure for parallel scientific applications on computational grids*.
- Rs. 8,00,000 (US \$16,000). Indian Institute of Science. Part (2A) Grant (252/SERC). November 2004 - December 2005. With Prof. R. Govindarajan, SERC, IISc. *Connecting 2 clusters*.
- Rs. 15,22,593 (US \$35,000). Microsoft Research. February 2005 - March 2006. *Parallel Numerical Applications as Web Services*.
- Rs. 12,00,000 (US \$24,000). Indian Institute of Science. Part (2A) Special Grant (45/SERC). January 2003 - January 2004. *Development of Grid Computing*.

Other Projects

- Top Supercomputers-India. A project that lists the top supercomputers in India. URL: <http://topsupercomputers-india.iisc.ernet.in>.

Honors, Awards

- Outstanding Reviewer Status for Journal of Parallel and Distributed Computing, May 2015.
- NVIDIA Innovation Award. For the project “GPU-enabled Efficient Executions of Radiation Calculations on GPUs.”. 2013.
- Yahoo! Faculty Research Award, 2011.
- Indian National Academy of Engineering (INAE) Young Engineer Award, 2009.
- University of Tennessee citation for Extraordinary Professional Promise, 2003.

Professional Activities

Editorial Board

- Associate Editor, IEEE Transactions on Parallel and Distributed Processing System (TPDS), 2014-date.
- Member, ACM Senior Member Award Committee, 2015-date.

Chair

- Session Chair - Algorithms, International Conference on Supercomputing (ICS), 2013.
- Chair, Student Affairs Committee, 15th ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming (PPoPP), 2010.
- Track Chair, Parallel/Grid Computing Systems track, 17th International Conference on Advanced Computing and Communications (ADCOM), 2009.
- Chair, Session on Garuda usage policies. 3rd Garuda Partners Meet, Bangalore, India. 2008.
- Chair, Session on Performance, 3rd IEEE International Conference on e-Science and Grid Computing, 2007.
- Tutorial Chair, 3rd IEEE International Conference on e-Science and Grid Computing, 2007.

Program Committee

- International Conference on High Performance Computing, HiPC: 2008, 2010-2015.
- IEEE/ACM Supercomputing (SC) conference Posters, 2015.
- IEEE Cluster conference, 2015, 2014.
- IEEE/ACM Supercomputing (SC) conference Birds-of-a-Feather (BoF), 2014.
- International Symposium on Cluster, Cloud and Grid Computing, CCGrid: 2006, 2010, 2011, 2014.
- IEEE International Parallel and Distributed Processing Symposium, IPDPS: 2007, 2014.
- IEEE International Conference on High Performance Computing and Communications, HPCC: 2005, 2009, 2011-2013.

- Student Research Symposium, International Conference on High Performance Computing, HiPC: 2009-2012.
- International Conference on Parallel Programming, ICPP: 2009.
- International Conference on Advanced Computing and Communications (ADCOM), 2009.
- Workshop on Scheduling and Resource Management for Parallel and Distributed Systems, SRMPDS: 2007, 2008.
- IEEE International Conference on e-Science and Grid Computing: 2005, 2007.
- Joint Workshop on High-Performance Grid Computing and High-Level Parallel Programming Models, HIPS-HPGC: 2005.

Reviewer

- Parallel Computing journal (ParCo): 2013, 2015.
- Journal of Parallel and Distributed Computing, JPDC: 2004, 2005, 2008-2015.
- IEEE Transactions on Computers (TC), 2015.
- International Journal of High Performance Computing Applications (IJHPCA), 2014.
- Journal of Supercomputing (JSC), 2014.
- Concurrency & Computing: Practice & Experience (CPE), 2014.
- IEEE Transactions on Cloud Computing, TCC: 2013.
- IEEE Transactions on Parallel and Distributed Systems, TPDS: 2010-2013.
- ACM Transactions on Computers: 2011, 2012.
- ACM Computing Surveys: 2011.
- Future Generation Computer Systems, FGCS: 2007, 2008.
- ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming, PPOPP: 2008.
- EuroPar: 2005.
- Journal of Grid Computing: 2005.
- International Conference on High Performance Computing, HiPC: 2004.

Organizer

- Co-organized Indo-US Workshop on Computational Science and Data Engineering (CS&DE), held in conjunction with International Conference on High Performance Computing (HiPC), 2014.

Graduate Students

1. Surendra Prasad, Ph.D, *August 2015 – date.*
2. Preeti Malakar, Ph.D, *August 2008 – April 2014.*
3. Sivagama Sundari, Ph.D, *August 2005 – July 2011.*
4. H.A. Sanjay, Ph.D, *August 2005 – June 2009.*

5. Rintu Panja, M.Sc (Engg.), *August 2015 – date.*
6. Ashirbad Mishra, M.Sc (Engg.), *August 2013 – date.*
7. Prakash Murali, M.Sc (Engg.), *August 2012 – April 2015.*
8. R. Vasudevan, M.Sc (Engg.), *August 2011 – December 2014.*
9. Cijo George, M.Sc (Engg.), *August 2010 – March 2013.*
10. Hari Raghavan, M.Sc (Engg.), *August 2010 – February 2013.*
11. Rajath Kumar, M.Sc (Engg.), *August 2010 – April 2013.*
12. Yadnyesh Joshi, M.Sc (Engg.), *August 2005 – November 2007.*
13. Rakhi Gupta, M.Sc (Engg.), *August 2004 – March 2007.*
14. Sandip Tikar, M.Sc (Engg.), *January 2004 – December 2006.*
15. Vineetha K, M.Tech, *August 2014 – 2016.*
16. Sabyasachi Sahoo, M.Tech, *August 2014 – 2016.*
17. Anurag Murty, M.Tech, *August 2011 – 2013.*
18. K Saikiran Murty, M.Tech, *August 2011 – 2013.*
19. K Vivek Murty, M.Tech, *August 2011 – 2013.*
20. Gowthami Manogna Gottipati, M.Tech, *August 2010 – 2012.*
21. T. Santanu, M.Tech, *August 2010 – 2012.*
22. Sharat Chandra Racha, M.Tech, *August 2010 – 2012.*
23. Jitender Singh, M.Tech, *August 2008 – July 2010.*
24. J. Sivabhavani, M.E., *August 2008 – July 2010.*
25. Priyank Raj, M.Tech, *August 2007 – July 2009.*
26. Karthikeyan Raman, M.Tech, *August 2006 – July 2008.*
27. Antoine Henry, Student Intern from INSA, Lyon, France, *January 2007 – July 2007.*

Teaching

1. Indian Institute of Science, SE 295, *Parallel Programming*: Spring 2004-2014.
2. Indian Institute of Science, SE 286, *Data Structures and Programming*: Fall 2014.
3. Indian Institute of Science, SE 292, *High Performance Computing*: Fall 2009-2013, 2015.
4. Indian Institute of Science, SE 293, *Topics in Grid Computing*: Fall 2004-2007.

Memberships

IEEE, ACM.

Research Statement

I am the founder-convener of Middleware and Runtime Systems Lab (MARS) in Supercomputer Education and Research Centre (SERC), Indian Institute of Science (IISc). The lab (<http://mars.serc.iisc.ernet.in>), established in 2004, focuses on research in High Performance Computing (HPC) involving challenging parallel applications (large-scale, long-running, dynamic, irregular, multi-component etc.) and challenging parallel systems, namely, GPUs, state-of-art supercomputers and grids. We are specifically interested in the following areas, namely, *Application Frameworks*, *Middleware for production supercomputers*, and *Fault tolerance*.

Application Frameworks

This work involves building generic frameworks, runtime strategies, user interfaces and abstractions, and programming models for applications on accelerator-based systems and Torus networks. We focus on three classes of applications, namely, irregular, multi-physics and climate/weather modeling applications.

Runtime Frameworks for Irregular Applications on GPU Systems: The research is on developing load balancing strategies, data layout optimizations and dynamic scheduling of both graph-based and scientific applications. We have developed dynamic load balancing using node splitting for graph-based applications including BFS, SSSP and Delaunay triangulation. We have also developed bin-packing based load balancing on GPUs, knap-sack formulation of asynchronous executions on CPUs and GPUs and kernel optimizations for AMR applications.

Runtime Frameworks for Hybrid Executions on GPU Systems: The aim is to develop generic strategies for hybrid asynchronous executions of applications on both CPU and GPU cores for their effective use. This research involves auto-identification of different possible hybrid execution models, developing user abstractions, performance modeling of application tasks on CPUs and GPUs, dynamic scheduling and data management. Our current research is with betweenness centrality problem.

Efficient Executions of Programming Models on GPU Systems: The aim is to deal with challenges that arise out of executing different programming models on GPU systems. Our recent work is on developing user abstractions and runtime strategies for efficient executions of asynchronous message-passing applications written in Charm++ on GPUs. We developed techniques for dynamic scheduling, data management and kernel coalescing. This work will be extended to include other programming models including Cilk and X!0.

Mapping and Remapping Strategies for Torus Networks: This research is on building efficient mapping and remapping/rescheduling strategies for irregular, multi-physics, climate/weather applications on torus networks that are popular network topologies in many modern supercomputers. We have developed processor allocation, mapping and reallocation strategies for simultaneous executions of nested simulations in weather modeling applications that involve dynamically varying weather phenomena like tracking cyclones, and rain clouds.

Middleware for Batch Systems

Batch systems and queues are used in many production and research-based supercomputer systems. Our research aims to build a middleware framework that interfaces between the users and the batch queues and systems. The middleware will have prediction techniques that predict queue waiting times and the execution times incurred by the parallel jobs submitted to the batch queues, and scheduling strategies that use these prediction techniques to assign the appropriate batch queue

and number of processors for job execution with the aim of reducing the turnaround times of the users and increasing the throughput of the system. We have developed techniques for predicting jobs that have short queue waiting times (quick starters).

Fault-tolerance

Our lab has investigated the use of replication for fault tolerance. The novelty is that instead of replicating all the processes, thereby resulting in only about 50% application efficiency in the presence of failures, our methods replicate a small subset of processes (typically, less than 1%) based on failure predictions. We demonstrated the effectiveness of this strategy for current peta-scale and future exa-scale systems. Our research also built a MPI library that uses this partial replication technique.

Past Research

Our past research includes:

- Framework for Weather Modeling.
- Climate Modeling on Grids.
- Bioinformatics on Grids.
- Scheduling and rescheduling tightly-coupled applications on grids and clusters.
- Fault Tolerance using Checkpointing.
- Collective communications on grids, Data Grids.