Jahanzeb Maqbool Hashmi

https://jahanzeb-hashmi.github.io

Summary

With over 15 years of experience in High Performance Computing (HPC), I drive technical strategy for next-generation GPU and datacenter systems, collaborating with cross-functional teams spanning Hardware, Software, and Product to define architecture direction and evaluate design trade-offs from chip-level to rack-scale NVLink platforms. My work has shaped multiple NVIDIA GPU generations—from Hopper through Rubin and beyond—through architectural feature exploration, hardware/software co-design, workload modeling, and competitive analysis, with recommendations presented to executive leadership, including the CEO.

Education

Ph.D. in Computer Science and Engineering, The Ohio State University, Columbus, Ohio, USA 2015 – 2020

Thesis: Designing High Performance Shared-Address-Space and Adaptive Communication Middlewares for Next-Generation HPC Systems
Advisor: Dhabaleswar K. (DK) Panda
Skills Learned: R&D of communication libraries (MPI, PGAS) on parallel architectures (CPUs, GPUs, Networks), architecture-aware algorithm design, performance engineering and optimizations on large-scale systems, optimal workload mapping on heterogeneous architectures

M.S. in Computer Engineering, Ajou University, Suwon, South Korea 2012 – 2014

Thesis: Exploring Performance and Efficiency of Multicore ARM Cluster for High Performance Computing
Skills Learned: Performance benchmarking, Application evaluations on parallel architectures

B.S. Information Technology, National University of Science and Technology, Islamabad, Pakistan 2007 – 2011

Thesis: Implementation and Evaluation of Scientific Simulations on HPC Architectures
Skills Learned: Parallel Programming (MPI, Open MP, CUDA), Porting serial codes to Parallel

Professional Experience

- **Senior High Performance Compute Architect,** NVIDIA Corporation, USA. March 2021 - Present
  - Leading cross-org path-finding efforts to analyze design trade-offs of building scale-up and scale-out systems. My work provides insights into NVIDIA's product positioning and is directly reported to E-staff and the CEO of the company.
  - Leading the architectural feature exploration and value proposition of next-generation NVIDIA GPU architecture for HPC, Industrial, and AI applications. I have contributed to several design PORs and provided quantitative data to get them approved across several generations of NVIDIA products starting from Hopper to Rubin and several upcoming products.
  - Identify application scaling challenges and co-design applications across HW/SW design space to achieve maximum performance, energy efficiency, and TCO on NVIDIA platforms.
  - Model business critical workloads to establish performance targets for NVIDIA's upcoming architectures to serve as north star for system bringup teams.
  - Lead the HPC competitive analysis working group, projecting application and system performance — from kernel/chip-level analysis to full-scale datacenter architecture — on competitive GPU/accelerator products
- **Senior Research Associate,** The Ohio State University, USA. June 2020 - March 2021
  - Worked on the design and development of high-performance MPI library for next-generation HPC and Cloud systems with multi-core CPUs (AMD Rome, Intel Xeon, IBM POWER9, ARM A64FX) and many-core GPUs (NVIDIA, AMD).
  - Led the design and development of a generalized hierarchical MPI collective communications framework for modern CPU and GPU systems.
  - Led the design and development of MVAPICH2-GDR, a high-performance GPU-aware MPI library, for NVIDIA and AMD based multi-GPU systems.
  - Mentoredand guiding Ph.D. and Masters students on various areas of research and development. This includes novel algorithms and designs for MPI communication protocols, software best practices, debugging and performance characterizations of distributed software stacks.

- **Graduate Research Associate,** The Ohio State University, USA. Aug 2016 - May 2020
  - Designed an adaptive and topology aware algorithm for mapping of MPI processes to hardware cores by capturing the communication-patterns of AI and HPC applications.
  - Worked collaboratively on efficient parallelization of large-scale distributed DNN training (data and model parallel) on CPU and GPU systems
  - Designed and developed a truly zero-copy XPMEM-based inter-process (IPC) communication with shared address space principle targeting manycore architectures.
  - Designed a novel algorithm to cache data layouts to help mitigate the performance costs of layout translation of MPI derived datatypes. This work was nominated for the Best Paper Award at IPDPS'19.
  - Worked on PGAS libraries e.g., OpenSHMEM, UPC++ and task-based programming models e.g., Kokkos with MPI backend
- **Department Fellow,** The Ohio State University, USA. Aug 2015 - July 2016
  - I was awarded the prestigious Department Fellowship by Ohio State University. Under the fellowship, I made research contributions to *PGAS over MPI* project at Network Based Computing Laboratory.
  - I designed, developed, and analyzed an MPI based communication conduit for UPC++ asynchronous PGAS programming model.
  - I implemented an MPI+UPC++ hybrid version of popular LULESH application and demonstrated the performance benefits against pure MPI or UPC++ implementations.
- **Research Assistant,** WISE Lab, Ajou University, South Korea. 2012 – 2014
  - Conducted research on energy-efficiency of ARM based SoC clusters for HPC workloads.
  - Secured grant from National Research Foundation (NRF), South Korea to setup a prototype cluster of ARM based SoC boards.
  - Setup a 64-node ARM SoC cluster with all the management software and ran experimental evaluations using various scientific applications and benchmarks.

Research Publications

For complete list of publications, please refer to my Google Scholar.

Refereed Journal Publications

J.3 [JPDC] **J. Hashmi**, C. Chu, S. Chakraborty, M. Bayatpour, H. Subramoni, and D. K. Panda. "FALCON-X: Zero-copy MPI Derived Datatype Processing on Modern CPU and GPU Architectures", submitted to special issue of *Journal of Parallel and Distributed Computing*.

J.2 [IEEE Access] F. Iqbal, **J. Hashmi**, B. Fung, R. Batool, A. Khattak, S. Aleem, and P. Hung. "A Hybrid Framework for Sentiment Analysis Using Genetic Algorithm Based Feature Reduction", in *IEEE Access*, Volume 7, 2019, Pages 14637 - 14652, `https://doi.org/10.1109/ACCESS.2019.2892852`.

J.1 [CCPE] **J. Hashmi**, S. Oh, and G. C. Fox. "Evaluating ARM HPC Clusters for Scientific Workloads", in *Concurrency and Computation: Practice and Experience*, Volume 27, Issue 17, Dec. 2015, Pages 5390-5410, `https://doi.org/10.1002/cpe.3602`.

Refereed Conference Publications

C.21 [HiPC '21] B. Ramesh, **J. Hashmi**, S. Xu, A. Shafi, M. Ghazimirsaeed, M. Bayatpour, H. Subramoni, and D. K. Panda. "Towards Architecture-aware Hierarchical Communication Trees on Modern HPC Systems", in proceeding of *28th IEEE International Conference on High Performance Computing, Data, Analytics and Data Science*, Dec. 2021. [Best Paper Finalist]

C.20 [ISC '21] K. Khorassani, **J. Hashmi**, , C. Chu, H. Subramoni, and D. K. Panda. "Designing a ROCm-aware MPI Library for AMD GPUs: Early Experiences", accepted at *International Supercomputing Conference (ISC)*, Jun 2021.

C.19 [ISC '21] M. Bayatpour, N. Sarkauskas, H. Subramoni, **J. Hashmi**, , and D. K. Panda. "BluesMPI: Efficient MPI Non-blocking Alltoall Offloading Designs on Modern BlueField Smart NICs", accepted at *International Supercomputing Conference (ISC)*, Jun 2021.

C.18 [CCGRID '21] A. Shafi, **J. Hashmi**, , H. Subramoni, D. K. Panda. "Efficient MPI-based Communication for GPU-Accelerated Dask Applications", in proceeding of *The 21st IEEE/ACM International Symposium on Cluster, Cloud, and Internet Computing*, May 2021.

C.17 [HiPC '20] A. Shafi, **J. Hashmi**, H, Subramoni, and D. K. Panda. "Blink: Towards Efficient RDMA-based Communication Coroutines for Parallel Python Applications", in proceeding of *27th IEEE International Conference on High Performance Computing, Data, Analytics and Data Science*, Dec. 2020.

C.16 [SC '20] A. Jain, A. Awan, A. Aljuhani, **J. Hashmi**, Q. Anthony, H. Subramoni, D. Panda, R. Machiraju, A. Parwani. "GEMS: GPU Enabled Memory Aware Model Parallelism System for Distributed DNN Training", accepted at *IEEE/ACM International Conference for High Performance Computing, Networking, Storage, and Analysis*, Nov 2020.

C.15 [IPDPS '20] **J. Hashmi**, S. Xu, B. Ramesh, M. Bayatpour, H. Subramoni, and D. K. Panda. "Machine-agnostic and Communication-aware Designs for MPI on Emerging Architectures", presented at *34th IEEE International Parallel and Distributed Processing Symposium*, May 2020.

C.14 [ISC '20] M. Bayatpour, **J. Hashmi**, S. Chakraborty, K. K. Suresh, M. Ghazimirsaeed, B. Ramesh, H. Subramoni, and D. K. Panda. "Communication-Aware Hardware-Assisted MPI Overlap Engine", accepted at *International Supercomputing Conference (ISC)*, Jun 2020.

C.13 [HiPC '19] C. Chu, **J. Hashmi**, K. S. Khorassani, H. Subramoni, and D. K. Panda. "High-Performance Adaptive MPI Derived Datatype Communication for Modern Multi-GPU Systems", in proceeding of *26th IEEE International Conference on High Performance Computing, Data, Analytics and Data Science*, Dec. 2019.

C.12 [IPDPS '19] **J. Hashmi**, S. Chakraborty, M. Bayatpour, H. Subramoni, D. K. Panda. "FALCON: Efficient Designs for Zero-copy MPI Datatype Processing on Emerging Architectures", in proceeding of *33rd IEEE International Parallel and Distributed Processing Symposium*, May 2019. [Best Paper Finalist]

C.11 [CCGRID '19] **J. Hashmi**, S. Chakraborty, M. Bayatpour, H. Subramoni, D. K. Panda. "Design and Characterization of Shared Address Space MPI Collectives on Modern Architectures", in proceeding of *The 19th IEEE/ACM International Symposium on Cluster, Cloud, and Grid Computing*, May 2019.

C.10 [SC '18] S. Chakraborty, M. Bayatpour, **J. Hashmi**, H. Subramoni, D. K. Panda. "Cooperative Rendezvous Protocols for Improved Performance and Overlap", in proceeding of *IEEE/ACM International Conference for High Performance Computing, Networking, Storage, and Analysis*, Nov 2018. [Best Paper Finalist]

C.9 [CLUSTER '18] M. Bayatpour, **J. Hashmi**, S. Chakraborty, H. Subramoni, P. Kousha, D. K. Panda. "SALaR: Scalable and Adaptive Designs for Large Message Reduction Collectives", in proceeding of *IEEE Cluster 2018*, Sep 2018. [Best Paper Award]

C.8 [IPDPS '18] **J. Hashmi**, S. Chakraborty, M. Bayatpour, H. Subramoni, D. K. Panda. "Designing Efficient Shared Address Space Reduction Collectives for Multi-/Many-cores", in proceeding of *32nd IEEE International Parallel and Distributed Processing Symposium*, May 2018.

C.7 [HiPC '17] **J. Hashmi**, K. Hamidouche, H, Subramoni, and D. K. Panda. "Kernel-assisted Communication Engine for MPI on Emerging Manycore Processors", in proceeding of *24th IEEE International Conference on High Performance Computing, Data, Analytics and Data Science*, Dec. 2017.

C.6 [ICPP '17] C. Chu, X. Lu, A. Awan, H. Subramoni, **J. Hashmi**, B. Elton, and D. K. Panda. "Efficient and Scalable Multi-Source Streaming Broadcast on GPU Clusters for Deep Learning", in proceeding of *International Conference on Parallel Processing*, Aug. 2017.

C.5 [PPoPP '17] A. Awan, K. Hamidouche, **J. Hashmi**, and D. K. Panda. "S-Caffe: Co-designing MPI Runtimes and Caffe for Scalable Deep Learning on Modern GPU Clusters", in proceeding of *22nd ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming*, February 2017.

C.4 [HPCC '16] **J. Hashmi**, K. Hamidouche, and D. K. Panda. "Enabling Performance Efficient Runtime Support for Hybrid MPI+UPC++ Programming Models", in proceeding of *18th IEEE International Conference on High Performance Computing and Communications*, Dec. 2016.

C.3 [KSCI '14] **J. Hashmi**, P. N. Rizki, and S. Oh. " Comparing Energy Efficiency of MPI and MapReduce on ARM based Cluster" *49th Korea Society of Computer Information Conference*, 2014. [Best Paper Award]

C.2 [ICIS '13] R. Batool, A. Khattak, **J. Hashmi**, and S. Lee. "Precise Tweet Classification and Sentiment Analysis", in proceeding of *12th IEEE/ACIS International Conference on Computer and Information Science*, 2013.

C.1 [ISSDM '12] R. Batool, W. Khan, M. Hussain, **J. Hashmi**, M. Afzal, and S. Lee. "Towards personalized health profiling in social network", in proceeding of *6th International Conference on New Trends in Information Science, Service Science and Data Mining*, 2012.

Refereed Workshop Publications

W.8 [SC '20] B. Ramesh, K. Suresh, N. Sarkauskas, M. Bayatpour, **J. Hashmi**, H. Subramoni, and D. K. Panda. "Scalable MPI Collectives using SHARP: Large Scale Performance Evaluation on the TACC Frontera System", in proceeding of *Annual Workshop on ExaScale MPI (ExaMPI)*, held in conjunction with SC '20, Nov. 2020.

W.7 [SC '20] S. Xu, M. Ghazimirsaeed, **J. Hashmi**, H. Subramoni, and D. K. Panda. "MPI Meets Cloud: Case Study with Amazon EC2 and Microsoft Azure", in proceeding of *Third Annual Workshop on Emerging Parallel and Distributed Runtime Systems and Middleware (IPDRM)*, held in conjunction with SC '20, Nov. 2020.

W.6 [SC '20] S. Khuvis, K. Tomko, **J. Hashmi**, H. Subramoni, and D. K. Panda. " Exploring Hybrid MPI+Kokkos Tasks Programming Model", in proceeding of *The 3rd Annual Parallel Applications Workshop, Alternatives to MPI+X (PAW-ATM)*, held in conjunction with SC '20, Nov. 2020.

W.5 [IPDPS '20] K. K. Suresh, B. Ramesh, M. Ghazimirsaeed, M. Bayatpour, **J. Hashmi**, H. Subramoni, and D. K. Panda. " Performance Characterization of Network Mechanisms for Non-Contiguous Data Transfers in MPI", in proceeding of *The 2020 IEEE International Parallel and Distributed Processing Symposium Workshops (IPDPSW)*, June 2020.

W.4 [SC '19] S. Xu, **J. Hashmi**, S. Chakraborty, H. Subramoni, and D. K. Panda. "Design and Evaluation of Shared Memory Communication Benchmarks on Emerging Architectures using MVAPICH2", in proceeding of *Third Annual Workshop on Emerging Parallel and Distributed Runtime Systems and Middleware (IPDRM)*, held in conjunction with SC '19, Nov. 2019.

W.3 [SC '19] A. Ruhela, B. Ramesh, S. Chakraborty, H. Subramoni, **J. Hashmi**, D. K. Panda. "Leveraging Network-level parallelism with Multiple Process-Endpoints for MPI Broadcast", in proceeding of *Third Annual Workshop on Emerging Parallel and Distributed Runtime Systems and Middleware (IPDRM)*, held in conjunction with SC '19, Nov. 2019.

W.2 [IXPUG '17] **J. Hashmi**, M. Li, H. Subramoni, and D. K. Panda. "Performance of PGAS Models on KNL: A Comprehensive Study with MVAPICH2-X", *Intel Xeon Phi User's Group Meeting*, Sep. 2017

W.1 [OpenSHMEM '17] **J. Hashmi**, M. Li, H. Subramoni, and D. K. Panda. "Exploiting and Evaluating OpenSHMEM on KNL Architecture", in proceeding of *Fourth Workshop on OpenSHMEM and Related Technologies*, Aug. 2017

Poster Publications

P.3 [SC '19] **J. Hashmi** and D. K. Panda. "Designing Next-Generation Communication Middlewares for Many-core Architectures", Doctoral Showcase poster at *IEEE/ACM International Conference for High Performance Computing, Networking, Storage, and Analysis*, Denver, CO. Nov. 2019.

P.2 [ISC '19] M. Bayatpour, **J. Hashmi**, S. Chakraborty, H. Subramoni, and D. K. Panda. "Reduction Operations on Modern Supercomputers: Challenges and Solutions", in proceeding of *International Supercomputing Conference*, June 2019. [Best Poster Award]

P.1 [SC '18] **J. Hashmi** and D. K. Panda. "Designing Shared Address Space MPI libraries in the Many-core Era", ACM Student Research Competition (SRC) poster at *IEEE/ACM International Conference for High Performance Computing, Networking, Storage, and Analysis*, Dallas, TX. Nov. 2018.

Technical Talks and Tutorials

T.7 InfiniBand, High-speed Ethernet, RoCE, Omni-Path, EFA, and Slingshot for Beginners, tutorial at SC '20 (Virtual)

T.6 InfiniBand, Omni-Path, and High-Speed Ethernet: Advanced Features, Challenges in Designing HEC Systems and Usage, tutorial at SC '19, Denver, CO.

T.5 Designing Next-Generation Communication Middlewares for Many-core Architectures, doctoral showcase at SC '19, Denver, CO.

T.4 SALaR: Scalable and Adaptive Designs for Large Message Reduction Collectives, presented at IEEE Cluster, Belfast, UK. [Best Paper Award Presentation]

T.3 Designing Efficient Shared Address Space Reduction Collectives for Multi-/Many-cores, presented at IPDPS '18, Vancouver, CA.

T.2 Designing High-Performance and Scalable Collectives for the Many-core Era: The MVAPICH2 Approach, invited talk at KAUST, Saudi Arabia

T.1 MVAPICH2-X: Unified Communication Runtime for Efficient Hybrid MPI+PGAS Programming Models, PGAS booth at SC '17, Denver, CO.

Professional Service

Program Committee

- 36th IEEE International Parallel and Distributed Processing Symposium (IPDPS '22)
- 28th IEEE Hot Interconnect Symposium (HotI '21)
- IEEE MICRO Journal (Special Edition) (Fall 2021)

Reviewer:

- 34th IEEE International Parallel and Distributed Processing Symposium (IPDPS '20)
- 37th IEEE International Conference on Computer Design (ICCD '19)
- International Conference for High Performance Computing, Networking, Storage, and Analysis (SC '19)
- International Supercomputing Conference (ISC '19)
- Journal of Parallel Computing (PARCO '18)
- 5th Workshop on OpenSHMEM and Related Technologies (OpenSHMEM '18)
- 20th IEEE International Conference on Cluster Computing (Cluster '18)
- 25th European MPI Users Group Meeting (EuroMPI '18)
- 32nd ACM International Conference on Supercomputing (ICS '18)
- 4th Workshop on OpenSHMEM and Related Technologies (OpenSHMEM '17)
- 24th European MPI Users Group Meeting (EuroMPI '17)
- 19th IEEE International Conference on Cluster Computing (Cluster '17)
- International Conference for High Performance Computing, Networking, Storage, and Analysis (SC '17)
- 31st ACM International Conference on Supercomputing (ICS '17)
- Journal of Parallel Computing (PARCO '17)

Honors, Awards, and Recognitions

Awards and Distinctions

- Best Student Research Poster Award, College of Engineering, OSU 2020
- Best Paper Finalist at IPDPS '19, Brazil. [Rank: Top-4, Accepted: 103, Total: 372] 2019

- 1st prize in Software Project Exhibition Contest (SPEX '10), Pakistan. 2010
- 1st prize Social Entrepreneurship Idea Contest organized by industry, Pakistan. 2010

Fellowships/Scholarships

- Department Fellowship in Computer Science and Engineering, OSU. [Rank: Top-2% Ph.D. admits] 2015
- Global IT Talents Fellowship by South Korean Ministry of Education for M.S. studies. 2012
- Prime Minister's National ICT Scholarship for fully funded undergraduate studies. 2007
- NUST Merit Scholarship for 5 out of 8 semesters at NUST-SEECS. 2007
- National Talented Science Student Award by Inter Board Committee of Chairmen (IBCC), Pakistan for outstanding performance in secondary school examination. [Rank: Top-10/60,000] 2003

Travel Grants

- IEEE TCHPC Travel Award to present at SC '19 doctoral showcase. 2019
- ACM Student Travel Award to present at SC '18 ACM Student Research Competition. 2018
- NSF Student Travel Award for attending and presenting at CLUSTER '18. 2018
- NSF Student Travel Award for attending and presenting at IPDPS '18. 2018
- KAUST Travel Award for attending and delivering invited talk at KAUST, Saudi Arabia. 2018
- NTSC Travel Award to attend National Talented Science Students Conference, Pakistan. 2005

Technical Skills

- Hardware Software co-design for HPC and AI
- End-to-end system design and optimization for TCO
- Performance Engineering and benchmarking
- Parallel Programming Models and Runtimes — MPI, OpenMP, CUDA, OpenSHMEM, UPC++
- Languages — C, C++, Java, CUDA, Bash, C#, Python
- Distributed Deep Learning frameworks and Middlewares — Tensorflow, CNTK, PyTorch, Horovod
- Tools — GDB, Git, LaTeX, PerfAPI (PAPI), mpiP, Valgrind, Eclipse, Gnuplot
- Linux Kernel Development — Memory-mapped I/O, kernel modules, system calls.
- Strong programming, debugging, and problem solving skills.
- Experienced with large-scale software design, development, and release life-cycle.
- Strong communication and presentation skills.