Hang Liu

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Stevens Institute of Technology
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EDUCATION

2011 - 2017 **Ph.D.** in **High-Performance Computing**
Department of Electrical & Computer Engineering
The George Washington University
Adviser: H. Howie Huang

2007 - 2011 **B.E.** in **Software Engineering**
School of Software Engineering
Huazhong University of Science & Technology

EXPERIENCES

2019 - Present **Assistant Professor**, Department of Electrical & Computer Engineering
Stevens Institute of Technology

Summer 2019&2021 **Visiting Faculty**
Lawrence Berkeley National Laboratory
Host: Sherry X. Li & Aydin Buluc

2017 - 2019 **Assistant Professor**, Department of Electrical & Computer Engineering
University of Massachusetts Lowell

2011 - 2017 **Graduate Research Assistant**
The George Washington University
Adviser: H. Howie Huang

Summer 2014 **Research Intern**
NEC Laboratories at America
Mentor: Cheng-Hong Li

HONORS & AWARDS

2021 NSF CAREER Award
2021 DOE SRP Fellowship
2020 One of the Best Papers in VLDB'20
2019 NSF CRII Award
2019 DOE SRP Fellowship
2019 Champion of Graph Challenge Competition
2018 Champion of Graph Challenge Competition
2018 Best Dissertation Award, Electrical & Computer Engineering at GWU
2017 ICT Express Best Reviewer
2016 Phillip/Temofel Sprawcew Endowment Scholarship
2015 No. 1 Most Energy Efficient Graph Traversal at GreenGraph 500 (small graph category)

RESEARCH - PUBLICATIONS

Book Chapters

2018   Da Yan and **Hang Liu**. Parallel Graph Processing. In Encyclopedia of Big Data Technologies, *Springer*, 2018.

Journal Articles

2021   Anil Gaihre, Xiaoye S. Li, and **Hang Liu**. GSOFA: Scalable Sparse LU Symbolic Factorization on GPUs. In *IEEE Transactions on Parallel and Distributed Systems* (**TPDS**), 2021.

2021   Santosh Pandey, Zhibin Wang, Sheng Zhong, Chen Tian, Lingda Li, Adolfy Hoise, Xiaoye S. Li, Caiwen Ding, Dong Li, Bolong Zheng and **Hang Liu**. TRUST: Triangle Counting on GPUs. In *IEEE Transactions on Parallel and Distributed Systems* (**TPDS**), 2021.

2020   Xu Xiang, **Hang Liu**, Tian Lan, Suresh Subramaniam, Howie Huang. Optimizing Job Reliability Through Contention-Free, Distributed Checkpoint Scheduling. In *IEEE Transactions on Network and Service Management* (**TNSM**), 2020.

2017   Yunjie Zhao, Yiren Jian, Zhichao Liu, **Hang Liu**, Qin Liu, Chanyou Chen, Zhangyong Li, Lu Wang, H. Howie Huang, and Chen Zeng. Network Analysis Reveals the Recognition Mechanism for Dimer Formation of Bulb-type Lectins. *Scientific Reports, volume 7*. Nature Publishing Group. 2017.

2016   Rajat Mittal, Jung Hee Seo, Vijay Vedula, Young J Choi, **Hang Liu**, H. Howie Huang, Saurabh Jain, Laurent Younes, Theodore Abraham, and Richard T George. Computational Modeling of Cardiac Hemodynamics: Current Status and Future Outlook. In *Journal of Computational Physics (JCP)*. 305 (2016): 1065-1082.

Refereed Conference Proceedings

2021   Shiyang Chen, Shaoyi Huang, Santosh Pandey, Bingbing Li, Guang Gao, Long Zheng, Caiwen Ding and **Hang Liu**. E.T.: Rethinking Transformer Models on GPUs. In *Proceedings of the International Conference for High Performance Computing, Networking, Storage and Analysis (SC)*. ACM, 2021.

2021   Anil Gaihre, Da Zheng, Scott Weitze, Lingda Li, Caiwen Ding, Shuaiwen Song and **Hang Liu**. Dr. Top-k: Delegate Centric Top-k Computation on GPUs. In *Proceedings of the International Conference for High Performance Computing, Networking, Storage and Analysis (SC)*. ACM, 2021.

2021   Yijue Wang, Chenghong Wang, Zigeng Wang, Shanglin Zhou, **Hang Liu**, Jinbo Bi, Caiwen Ding, Sanguthevar Rajasekaran. Against Membership Inference Attack: Pruning is All You Need. In *Proceedings of the International Joint Conferences on Artificial Intelligence (IJCAI)*. 2021.

2021   Geng Yuan, Payman Behnam, Zhengang Li, Ali Shafiee, Sheng Lin, Xiaolong Ma, **Hang Liu**, Xuehai Qian, Mahdi Bojnordi, Yanzhi Wang, and Caiwen Ding. FORMS: Fine-grained Polarized ReRAM-based In-situ Computation for Mixed-signal DNN Accelerator. In *Proceedings of the 46th International Symposium on Computer Architecture (ISCA)*, 2021

2021   Zhen Xie, Wenqian Dong, Jiawen Liu, **Hang Liu** and Dong Li. Tahoe: Tree Structure-Aware High Performance Inference Engine for Decision Tree Ensemble on GPU. In *Proceedings of the European Conference on Computer Systems (Eurosys)*. ACM, 2021.

2020   Santosh Pandey, Lingda Li, Adolfy Hoisie, Xiaoye S. Li and **Hang Liu**. C-SAW: A Framework for Graph Sampling and Random Walk on GPUs. In *Proceedings of the International*

Conference for High Performance Computing, Networking, Storage and Analysis (SC). IEEE, 2020.

2020   Bolong Zheng, Xi Zhao, Lianggui Weng, Nguyen Quoc Viet Hung, **Hang Liu** and Christian S. Jensen. PM-LSH: A Fast and Accurate LSH Framework for High-Dimensional Approximate NN Search. In *Proceedings of the VLDB Endowment (VLDB)*. 2020. **One of the best papers in VLDB '20**.

2020   Bingbing Li, Zhenglun Kong, Tianyun Zhang, Ji Li, Zhengang Li, **Hang Liu**, Caiwen Ding. Efficient Transformer-based Large Scale Language Representations using Hardware-friendly Block Structured Pruning. In *Proceedings of ACL Empirical Methods in Natural Language Processing (EMNLP)*, 2020.

2020   Md Hafizul Islam Chowdhuryy, **Hang Liu**, Fan Yao, BranchSpec: Information Leakage Attacks Exploiting Speculative Branch Instruction Executions. In *Proceedings of the 38th IEEE International Conference on Computer Design (ICCD)*, 2020.

2020   Linnan Wang, Wei Wu, Junyu Zhang, **Hang Liu**, George Bosilca, Maurice Herlihy, and Rodrigo Fonseca. FFT-based Gradient Sparsification for the Distributed Training of Deep Neural Networks. In *Proceedings of the 29th International Symposium on High-Performance Parallel and Distributed Computing (HPDC)*, pp. 113-124. 2020.

2020   Runbin Shi, Yuhao Ding, Xuechao Wei, He Li, **Hang Liu**, Hayden So, and Caiwen Ding. Ftdl: A tailored fpga-overlay for deep learning with high scalability. In *ACM/EDAC/IEEE Design Automation Conference (DAC)*, 2020.

2020   Bingbing Li, Santosh Pandey, Haowen Fang, Yanjun Lyv, Ji Li, Jieyang Chen, Mimi Xie, Lipeng Wan, **Hang Liu**, and Caiwen Ding. FTRANS: energy-efficient acceleration of transformers using FPGA. In *Proceedings of the ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED)*, pp. 175-180. 2020.

2020   Shilong Wang, Da Li, Hengyong Yu and **Hang Liu**. ELDA: Efficient LDA on GPUs (short paper) In *In Proceedings of the 25th ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming (PPoPP)*. 2020.

2020   Runbin Shi, Yuhao Ding, Xuechao Wei, **Hang Liu**, So Hayden, and Caiwen Ding. Ftdl: An fpga-tailored architecture for deep learning applications (short paper). In *Proceedings of the 2020 ACM/SIGDA International Symposium on Field-Programmable Gate Arrays (FPGA)*. ACM, 2020.

2020   Yuede Ji, **Hang Liu**, Howie Huang. SwarmGraph: Analyzing Large-Scale In-Memory Graphs on GPUs. In the IEEE International Conference on High Performance Computing and Communications (**HPCC**), 2020.

2019   Santosh Pandey, Xiaoye S. Li, Aydin Buluc, Jiejun Xu and **Hang Liu**. H-INDEX: Hash-Indexing for Parallel Triangle Counting on GPUs. In *GraphChallenge*. 2019. **Awarded Champion**.

2019   Daniel Giger and **Hang Liu**. An Efficient Parallel Algorithm for Dominator Detection (ACM Undergraduate Poster Competition). In *Proceedings of the International Conference for High Performance Computing, Networking, Storage and Analysis (SC)*. 2019.

2019   **Hang Liu** and H. Howie Huang. SIMD-X: Programming and Processing of Graph Algorithms on GPUs. In *Proceedings of the 2019 USENIX Conference on Usenix Annual Technical Conference (USENIX ATC)*. USENIX Association. 2019.

2019

Anil Gaihre, Zhenlin Wu and **Hang Liu**. XBFS: eXploring Dynamic Optimizations for Breadth-First Search on GPUs. In *proceedings of the 28th international symposium on High-performance parallel and distributed computing (**HPDC**)*. ACM. 2019.

2019   Bibek Bhattarai, **Hang Liu** and H. Howie Huang. CECI: Compact Embedding Cluster Index for Scalable Subgraph Matching. In *Proceedings of ACM SIGMOD International Conference on Management of Data (**SIGMOD**)*. ACM, 2019.

2019   Eric Finnerty, Zach Sherer, Yan Luo and **Hang Liu**. Dr. BFS: Data Centric Breadth-First Search on FPGAs. In *56th ACM/ESDA/IEEE Design Automation Conference (**DAC**)*. IEEE. 2019.

2019   Hao Jin, Chen Xu, Yan Luo, Peilong Li, **Hang Liu** and Chunyang Hu. A Blockchain based Approach for Secure and Privacy-Preserving Medical Data Sharing. In *IFIP Networking Conference (**IFIP Networking**)*. IEEE. 2019. (WIP)

2019   Jialing Zhang, **Hang Liu** and Seung Woo Son. Efficient Encoding and Reconstruction of HPC Datasets for Checkpoint/Restart. In *35th Symposium on Mass Storage Systems and Technologies (**MSST**)* (pp. 1-12). IEEE. 2019.

2019   Zach Sherer, Eric Finnerty, Yan Luo and **Hang Liu**. Software and Hardware Co-Optimized BFS on FPGAs. In *Proceedings of the ACM/SIGDA International Symposium on Field Programmable Gate Arrays (**FPGA**)*. ACM, 2019.

2018   Anil Gaihre, Yan Luo and **Hang Liu**. Do Bitcoin Users Really Care About Anonymity: An Analysis of the Bitcoin Transaction Graph. In *Proceedings of IEEE International Conference on Big Data (**BigData**)*. IEEE, 2018.

2018   **Hang Liu**, Yang Hu and H. Howie Huang. High-Performance Triangle Counting on GPUs. In *GraphChallenge*. 2018. **Awarded Champion**.

2018   Yang Hu, **Hang Liu** and H. Howie Huang. TriCore: Parallel Triangle Counting on GPUs. In *Proceedings of the International Conference for High Performance Computing, Networking, Storage and Analysis (**SC**)*. IEEE, 2018.

2018   Yuede Ji, **Hang Liu** and H. Howie Huang. iSpan: Parallel Identification of Strongly Connected Components with Spanning Trees. In *Proceedings of the International Conference for High Performance Computing, Networking, Storage and Analysis (**SC**)*. IEEE, 2018.

2018   Nai Xia, Tian Chen, Yan Luo, **Hang Liu** and Xiaoliang Wang. UKSM: Swift Memory Deduplication via Hierarchical and Adaptive Memory Region Distilling. In *16th USENIX Conference on File and Storage Technologies (**USENIX FAST**)*. 2018.

2017   Aekyeung Moon, Jaeyoung Kim, Jialing Zhang, **Hang Liu** and SeungWoo Son. Understanding the Impact of Lossy Compressions on IoT Smart Farm Analytics. In *IEEE BigData Workshop on Big Data Analytics for Internet of Things*, 2017.

2017   **Hang Liu** and H. Howie Huang. Graphene: Fine-Grained IO Management for Graph Computing. In *15th USENIX Conference on File and Storage Technologies (**USENIX FAST**)*. 2017.

2016   **Hang Liu**, H. Howie Huang, and Yang Hu. iBFS: Concurrent Breadth-First Search on GPUs. In *Proceedings of ACM SIGMOD International Conference on Management of Data (**SIGMOD**)*. ACM, 2016.

2015   **Hang Liu** and H. Howie Huang. Enterprise: Breadth-First Graph Traversal on GPUs. In *Proceedings of the International Conference for High Performance Computing, Networking, Storage and Analysis (**SC**)*. ACM, 2015.

2014	Yu Xiang, **Hang Liu**, Tian Lan, H. Howie Huang, and Suresh Subramaniam. Optimizing Job Reliability via Contention-free, Distributed Scheduling of VM Checkpointing. In *Proceedings of the 2014 ACM SIGCOMM workshop on Distributed cloud computing (**DCC**).* ACM, 2014.
2014	H. Howie Huang and **Hang Liu**. Big Data Machine Learning and Graph Analytics: Current State and Future Challenges. In *International Conference on Big Data (**BigData**).* IEEE, 2014.
2013	**Hang Liu**, Jung-Hee Seo, Rajat Mittal, and H. Howie Huang. GPU-Accelerated Scalable Solver for Banded Linear Systems. In *International Conference on Cluster Computing (**CLUSTER**).* IEEE, 2013.
2012	**Hang Liu**, Jung-Hee Seo, Rajat Mittal, and H. Howie Huang. Matrix Decomposition Based Conjugate Gradient Solver for Poisson Equation (short paper). In *Proceedings of International Conference for High Performance Computing, Networking, Storage and Analysis (**SC**).* IEEE, 2012.

RESEARCH - GRANTS

NSF	*CAREER: A Framework for Graph Sampling and Random Walk on GPUs*
	• Role: Sole PI;
	• Total: $584,001;
	• Sponsor: National Science Foundation (#246102);
	• 2021.1 - 2025.12.

NSF	*CRII: SHF: Expediting Subgraph Matching on GPUs*
	• Role: Sole PI;
	• Total: $175,000;
	• Sponsor: National Science Foundation (#2000722);
	• Period: 2019.09 - 2022.01.

DOE	*GPU Accelerated Symbolic Factorization for SuperLU*
	• Role: Sole PI;
	• Total: $160,000;
	• Sponsor: Department of Energy (Lawrence Berkeley National Laboratory);
	• Period: 2019.09 - 2021.08.

DOE	*SIMNET: Deep Learning Accelerated Microarchitectural Simulator*
	• Role: Sole PI;
	• Total: $94,581;
	• Sponsor: Department of Energy (Brookhaven National Laboratory);
	• Period: 2020.06 - 2021.08.

LittleLights	*Knowledge Graph Assisted Scalable Adaptive Learning for LittleLights.AI*
	• Role: Sole PI;
	• Total: $50,725;
	• Sponsor: LittleLights.AI (Industry);
	• Period: 2018.08 - 2019.08.

Amazon	*Graph Mining at Extreme Scale*
	• Role: Sole PI;
	• Total: $68,000 (cloud credit);

- Sponsor: Amazon AWS;
- Period: 2018.07 - 2019.07.

Intel   *Real-Time Deep Learning on FPGAs*
- Role: Sole PI;
- Total: Stratix 10 FPGA (worth $10,000);
- Sponsor: Amazon AWS;
- Period: 2019.07.

Nvidia   *Expediting Asynchronous Graph Analytics on GPUs*
- Role: Sole PI;
- Total: Quadro P6000 GPU (worth $4,500);
- Sponsor: Nvidia;
- Period: 2018.07.

Nvidia   *Expediting Graph Mining on GPUs*
- Role: Sole PI;
- Total: Titan Xp GPU (worth $1,200);
- Sponsor: Nvidia;
- Period: 2017.10.

RESEARCH - Invited Talks

Jan.2021   How to Write Your NSF CAREER Proposal
Stevens Institute of Technology

Dec.2020   How to Write a Technical Paper for ECE Student Professional Development Workshop
Stevens Institute of Technology

Oct.2020   High-Performance Graph Sampling and Random Walk on GPUs
Brookhaven National Laboratory

July.2019   SIMD-X: Programming and Processing of Graph Algorithms on GPUs
USENIX ATC, Renton, WA

July.2019   Hardware Accelerated Data Science
Lawrence Berkeley National Laboratory, Berkeley, CA

June.2019   Dr. BFS: Data Centric Breadth-First Search on FPGAs
DAC, Las Vegas, NV

June.2019   Hardware Accelerated Data Analytics
Samsung Research Forum, San Jose, CA

June.2019   Hardware Accelerated Graph Computing, Mining and Learning
HRL Laboratories, Malibu, CA

April.2019   Graph Computing: System, Application and Future Directions
Massachusetts Institute of Technology, Cambridge, MA

Mar.2019   Hardware Accelerated Data Analytics
Stevens Institute of Technology, Hoboken, NJ

July.2018   High-Performance Graph Computing on GPUs
Nvidia Research, Westford, MA

Feb.2018	Novel Techniques for Graph Algorithm Acceleration *Brown University, Providence, RI*
Feb.2017	Novel Techniques for Graph Algorithm Acceleration *University of Massachusetts Lowell, Lowell, MA*
Feb.2017	Novel Techniques for Graph Algorithm Acceleration *University of North Carolina Charlotte, Charlotte, NC*
Jan.2017	Novel Techniques for Graph Algorithm Acceleration *Clemson University, Clemson, SC*
Feb.2017	Graphene: Fine-Grained IO Management for Graph Computing *USENIX FAST, San Jose, CA*
July.2016	iBFS: Concurrent Breadth-First Search on GPUs *SIGMOD, San Francisco, CA*
Nov.2015	Enterprise: Breadth-First Graph Traversal on GPUs *SC, Austin, TX*

TEACHING

2021 Spring	CPE 517-A: Digital and Computer Systems Architecture *Stevens Institute of Technology* (evaluation: 3.83/4)
2020 Fall	CPE 360-A: Computational Data Structure and Algorithms *Stevens Institute of Technology* (evaluation: 3.94/4)
2020 Spring	CPE 517-A: Digital and Computer Systems Architecture *Stevens Institute of Technology* (evaluation: 3.13/4)
2019 Fall	CPE 517-A: Digital and Computer Systems Architecture *Stevens Institute of Technology* (evaluation: 2.7/4)
2019 Spring	EECE 7110: High-Performance Computing on GPUs *University of Massachusetts Lowell*
2018 Fall	EECE4810/EECE5730: Opearting Systems *University of Massachusetts Lowell*
2018 Spring	EECE 7110: High-Performance Computing on GPUs *University of Massachusetts Lowell*

STUDENT ADVISING & MENTORING

PHD STUDENTS

2018	Anil Gaihre (2018.01 - Present) Dissertation Topic: High-Performance Data Analytics Systems
2019	Santosh Pandey (2019.01- Present) Dissertation Topic: Machine Learning Expedited Computer Architecture Simulation
	Shiyang Chen (2019.08 - Present) Dissertation Topic: Re-thinking Machine Learning Models on Emerging Accelerators
2020	Scott Weitze (2020.08 - Present) Dissertation Topic: Accelerating Data Mining With Graphics Processing Units

2021	Zhanfu Yang (2021.01 - Present) Dissertation Topic: High-Performance Graph Mining Systems

Master Students

2020	Zehui Xie (2020.01 - 2020.12) *Outstanding Master's Research Project Award*
	Yufeng Liu (2020.01 - 2020.12)
	Neel Haria, *Intern at Jabil* (2020.05 - 2020.12)
	Ghaith Arar, *Intern at Jabil* (2020.05 - 2020.12)
	Yupeng Cao & Yunxiang Yang (2020.01 - 2020.12) *ECE Honors Summer Research Program 3rd Place*

Undergraduate Students

2018	Daniel Giger (2018.07 - 2019.08) Topic: An Efficient Parallel Algorithm for Dominator Detection *ACM Undergraduate Poster Competition*
2020	Jared Kantor & Chris Waldt (2020.05 - 2020.12) Topic: 5G Phased Array Calibration *Senior Design Semi-Final & Intern at Jabil*
	Shivam Sheth (2020.07 - 2021.05) Topic: Graph Computing Assisted Latency Critical Job Scheduling on Supercomputers
2021	Jie Dai, *Intern at Jabil* (2021.06 - present)

PROFESSIONAL ACTIVITIES

Journal Editorship

2021	Associate Editor: Journal of BigData: Theory and Practice;

Conference Organizer

2021	Program Co-Chair: The workshop on Graph Techniques for Adversarial Activity Analytics 2021 (GTA^3 2021);

Technical Program Committee

2022	The ACM Symposium on Principles and Practice of Parallel Programming (*PPoPP*)
2022	The IEEE International Parallel & Distributed Processing Symposium (*IPDPS*)
2021	The International Conference for High Performance Computing, Networking, Storage, and Analysis (*SC*)
2021	The IEEE International Parallel & Distributed Processing Symposium (*IPDPS*)
2021	The ACM International Symposium on High-Performance Parallel and Distributed Computing (*HPDC*)
2020	The International Conference for High Performance Computing, Networking, Storage, and Analysis (*SC*)
2020	The IEEE International Parallel & Distributed Processing Symposium (*IPDPS*)
2020	

ACM International Symposium on High-Performance Parallel and Distributed Computing (*HPDC*)

2020   The IEEE International Conference on Distributed Computing Systems (*ICDCS*)

2020   SIAM Workshop on Combinatorial Scientific Computing (*CSC*)

2019   IEEE International Conference on Big Data (*BigData*)

2019   The ACM International Symposium on High-Performance Parallel and Distributed Computing (*HPDC*)

2018   The ACM International Symposium on High-Performance Parallel and Distributed Computing (*HPDC*)

2018   The IEEE International Parallel & Distributed Processing Symposium (*IPDPS*)

Journal Reviewer

2021   IEEE TC, IEEE TPDS, IEEE TCAD, IEEE ToCC

2020   IEEE TC, IEEE TPDS, IEEE TCAD, IEEE ToCC, IEEE TSC

2019   IEEE TC, IEEE TPDS, IEEE TOPC, IEEE TM, Elsevier Neurocomputing, IEEE TPPNA

2018   IEEE TC, IEEE TPDS, IEEE TOPC

2017   IEEE TC, IEEE TPDS

Panelist

2018 - 2021   National Science Foundation (NSF)

INTERNAL SERVICES

2021   Strategic Planning Committee, *Department of Electrical & Computer Engineering, Stevens Institute of Technology*

2020 - 2021   Graduate Student Recruitment Committee, *Department of Electrical & Computer Engineering, Stevens Institute of Technology*

2019 - 2021   Master Student Advisor, *Department of Computer Science, Stevens Institute of Technology*

2020 - 2021   Faculty candidate interview, *CS/ECE, Stevens Institute of Technology*