

Diksha Moolchandani

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Work Experience

Senior Research Scientist (Full-time) (July 2023 - present)
IMEC, Leuven, Belgium

Research Scientist (Full-time) (Jan. - Jun. 2023)
IMEC, Leuven, Belgium

Education

Ph.D. in Computer Science (Jan. 2016 - 2021)
Indian Institute of Technology Delhi (IIT Delhi)

Advisors: Prof. Smruti Ranjan Sarangi and Prof. Anshul Kumar

B.Tech. in Electronics and Communication Engineering (Aug 2011 - May 2015)
Indian Institute of Information Technology, Design and Manufacturing, Jabalpur (IIITDM Jabalpur)

Research Interests

- Computer Architecture for Computer Vision
- ML Accelerators
- ML applications in Computer Architecture
- Energy-efficient architecture design for UAVs and autonomous driving vehicles

Honors & Awards

- Featured in Forbes 30 under 30 Europe (category science and healthcare) (Mar. 2023)
Forbes
- Winner: Technical Blog Competition at IBM Research's flagship event Maitreyee (Sept. 2021)
IBM Research
- Selected to attend the 8th Heidelberg Laureate Forum (Sept. 2021)
Heidelberg, Germany
- Fellowship to attend Robotics: Science and Systems (RSS) (Jul. 2021)
virtual event
- Winner: Technical Blog Competition at IBM Research's flagship event Maitreyee (Oct. 2020)
IBM Research
- Scholarship with short stay: Ph.D. young researcher (Sept.-Nov. 2019)
Innopolis University, Russia

Publications

Analyzing GPU Energy Consumption in Data Movement and Storage

P. Delestrac, J. Miquel, D. Bhattacharjee, **D. Moolchandani**, F. Catthoor, L. Torres, and D. Novo
IEEE International Conference on Application-specific Systems, Architectures and Processors (ASAP) 2024

Multi-level Analysis of GPU Utilization in ML Training Workloads

P. Delestrac, D. Bhattacharjee, S. Yang, **D. Moolchandani**, F. Catthoor, L. Torres, and D. Novo
Design, Automation and Test in Europe Conference (DATE) 2024

AMPeD: An Analytical Model for Performance in Distributed Training of Transformers

D. Moolchandani, J. Kundu, F. Ruelens, P. Vrancx, T. Evenblij, and M. Perumkunnil
IEEE International Symposium on Performance Analysis of Systems and Software (ISPASS) 2023

Game Theory-based Parameter Tuning for Energy-efficient Path Planning on Modern UAVs

D. Moolchandani, K. Yadav, G. Prathap, I. Afanasyev, A. Kumar, M. Mazzara, and S.R. Sarangi
ACM Transactions on Cyber-Physical Systems, Oct. 2022

Performance and Power Prediction for Concurrent Execution on GPUs

D. Moolchandani, A. Kumar, and S.R. Sarangi
ACM Transactions on Architecture and Code Optimization, Sept. 2022, Vol. 19, Issue 3

Hardware-Assisted Mechanisms to Enforce Control Flow Integrity: A Comprehensive Survey

S. Kumar, **D. Moolchandani**, and S.R. Sarangi
Elsevier Journal of Systems Architecture (JSA), Sept. 2022, Vol. 130

PredStereo: An Accurate Real-Time Stereo Vision System

D. Moolchandani, N. Shrivastava, A. Kumar, and S.R. Sarangi
Winter Conference on Applications of Computer Vision (WACV) 2022

Game Theory-based Parameter-Tuning for Path Planning of UAVs

D. Moolchandani, G. Prathap, I. Afanasyev, A. Kumar, M. Mazzara, and S.R. Sarangi
International Conference on VLSI Design 2021

Accelerating CNN Inference on ASICs: A Survey

D. Moolchandani, A. Kumar, and S.R. Sarangi
Elsevier Journal of Systems Architecture (JSA), Feb. 2021, Vol. 113

VisSched: An Auction based Scheduler for Vision Workloads on Heterogeneous Processors

D. Moolchandani, A. Kumar, J.F. Martínez, and S.R. Sarangi
Full paper accepted in ESWEEK CASES 2020
Published in IEEE International Transactions on Computer-Aided Design of Integrated Circuits and Systems (IEEE TCAD), Nov. 2020, Vol. 39, Issue 11

Performance Prediction for Multi-Application Concurrency on GPUs

D. Moolchandani, S. Gupta, A. Kumar, and S.R. Sarangi
IEEE International Symposium on Performance Analysis of Systems and Software (ISPASS) 2020

A Machine to Machine framework for the charging of Electric Autonomous Vehicles

Z. Elbanna, I. Afanasyev, L.J.P. Araújo, R. Hussain, M. Khazeev, J. Lamptey, M. Mazzara, S.

Megha, **D. Moolchandani**, and D. Strugar

The Workshops of the IEEE International Conference on Advanced Information Networking and Applications (WAINA) 2020

F-LaaS: A Control-Flow-Attack Immune License-as-a-Service Model

S. Kumar, **D. Moolchandani**, T. Ono, and S.R. Sarangi

IEEE International Conference on Services Computing (SCC) 2019

Posters

Scheduling and Characterization of Computer Vision Workloads on Heterogeneous Systems

D. Moolchandani

Ph.D. Forum, Design Automation Conference (DAC) 2021

VisSched: An Auction based Scheduler for Vision Workloads on Heterogeneous Processors

D. Moolchandani, A. Kumar, J.F. Martínez, and S.R. Sarangi

Design Automation Conference (DAC) 2020

Patents

System and Method for Improving Stereo Vision Accuracy

Diksha Moolchandani, Nivedita Shrivastava, Anshul Kumar, and Smruti R. Sarangi

Filed at the Indian patent office. Date: June 24, 2021. Number: 202111028215

Research Software

AMPeD: An Analytical Model for Performance in Distributed Training of Transformers
(Mar-Sept. 2022)

- o An analytical model to predict the training times of transformers on different distributed multi-GPU systems
- o Exposes all the transformer model parameters, potential parallelism choices (along with their mapping onto the system), the accelerator and system architecture specifications
- o Released under the MIT license [here](#)

Tejas Power Pack

(Aug-Oct 2017)

Advisor: Prof. Smruti Ranjan Sarangi, IIT Delhi

- o Power model add-on for Tejas architectural simulator
- o Released under the open source Apache-v2 license [here](#)

Professional Experience

- o **Visiting Research Scholar** (Sept.-Nov. 2019)
Innopolis University, Republic of Tatarstan, Russia
- o **Project Associate** (Jun-Dec 2015)
IIT Delhi (Top-ranked institute in Computer Science and Engineering in India)
- o **Project Based Internship** (May-Dec 2014)
Bhabha Atomic Research Centre Mumbai (BARC Mumbai)

- o **Summer Internship** (May-Jul 2013)
BARC Mumbai
- o Summer training in Embedded Systems and Robotics, (May-Jun 2012)
BRiCS Simplifix Automation & Solutions Pvt. Ltd., IIT Kanpur

Teaching Experience

Computer Architecture	(Spring 2020)
<i>Instructor: Prof. Preeti Ranjan Panda</i>	
Accelerator Design for CNNs	(Spring 2020, Fall 2019)
<i>Instructor: Prof. Smruti Ranjan Sarangi</i>	
Operating Systems	(Spring 2019)
<i>Instructor: Prof. Smruti Ranjan Sarangi</i>	
Advanced Computer Architecture	(Fall 2018)
<i>Instructor: Prof. Smruti Ranjan Sarangi</i>	
Computer Architecture	(Spring 2018, Spring 2017)
<i>Instructor: Prof. Anshul Kumar</i>	
Digital Logic and System Design	(Fall 2017, Fall 2016)
<i>Instructor: Prof. Anshul Kumar</i>	

Student Mentoring

Kishore Yadav (Master's thesis)	2020-2021
<i>Unity-based simulator for drone swarms</i>	
Mohammad Atif (Bachelor's thesis)	2020-2021
<i>Self-driving simulator: lane change, steering, and braking</i>	
Satyam Jay (Master's project)	2020-2021
<i>Self-driving simulator: lane change, steering, and braking</i>	
Kishore Yadav, Yash Malviya, Aniket Kumar (Master's project)	2019-2020
<i>Self-driving simulator - detection, tracking, localization</i>	
Yash Singla, Pranay Singh, Mudit Soni (Winter Internship)	2019
<i>Added scenes and features to our self-driving car simulator</i>	
Chinmay Rai (Bachelor's thesis)	2019-2020
<i>Compiler for Tejas-CNN</i>	
Aditya Jain, Sarthak Vishnoi (Bachelor's thesis)	2019-2020
<i>Added multiple dataflows and DRAM module to Tejas-CNN</i>	
Shivangi Sharma, Ravi Prakash, Goverdhan Mishra (Summer Internship)	2019
<i>Tejas-CNN: Simulator for CNN accelerators (basic implementation)</i>	
Prabhleen Kaur (Master's thesis)	2018-2019
<i>Unity-based simulator for self-driving cars (basic)</i>	
Sudhanshu Gupta (Bachelor's thesis)	2018-2019
<i>Characterization of autonomous driving workloads</i>	

Rishabh Singh, Parul Gupta (Summer Internship) <i>Generic plotting library for the statistics generated by Tejas architectural simulator</i>	2018
Dhruv Mishra (Summer Internship) <i>Analyzed MEVBench suite for invariants using Daikon</i>	2018
Ryan Dsouza (Bachelor's thesis) <i>Extended Tejas x86 architectural simulator for SIMD instructions</i>	2017-2018

Talks & Seminars

- AMPeD: An Analytical Model for Performance in Distributed Training of Transformers
ISPASS 2023
- Scheduling and Characterization of Computer Vision Workloads on Heterogeneous Systems
virtually at DAC Ph.D. Forum (Dec. 2021)
- Game Theory-based Parameter-Tuning for Path Planning of UAV
virtually at IBM Research's flagship event Maitreyee (Sept. 2021)
- VisSched: An Auction-based Scheduler for Vision Workloads on Heterogeneous Processors
virtually at AMD Bangalore (Sept. 2021)
- Accelerating CNN Inference on ASICs: A Survey
virtually at Qualcomm Hyderabad (Sept. 2021)
- VisSched: An Auction-based Scheduler for Vision Workloads on Heterogeneous Processors
virtually at IMEC Belgium (July 2021)
- Game Theory-based Parameter-Tuning for Path Planning of UAV
virtually at VLSI Design (Feb. 2021)
- VisSched: An Auction-based Scheduler for Vision Workloads on Heterogeneous Processors
virtually at IBM Research's flagship event Maitreyee (Oct. 2020)
- VisSched: An Auction-based Scheduler for Vision Workloads on Heterogeneous Processors
virtually at ESWEK CASES (Sep. 2020)
- Performance Prediction for Multi-Application Concurrency on GPUs
virtually at ISPASS (Aug. 2020)
- VisSched: An Auction-based Scheduler for Vision Workloads on Heterogeneous Processors
virtually at DAC (July 2020)
- Benchmark Characterization and Optimizations for Path Planning of Drones
Innopolis University, Russia (Nov. 2019)
- Architectural Characterization of Vision Workloads
Innopolis University, Russia (Sept. 2019)
- Architectures for Vision and Image Processing Applications
PhD Symposium CSE IIT Delhi (Dec. 2017)
- Architectures for Vision and Image Processing Applications: Survey and Research Proposal
IIT Delhi, India (Jun. 2017)
- Implementation of FPGA based Communication Network using High Speed PCIe and Multi Gigabit Transceivers
National Workshop on Cryptology (NWC), 2014
- Implementation of FPGA based Communication Network using High Speed PCIe and Multi Gigabit Transceivers
Bhabha Atomic Research Center Mumbai (Aug. 2014)

Professional Service

- Artifact Evaluation Committee, ASPLOS 2023
- Reviewer for MLArchSys 2024, MLArchSys 2023, JSA Journal, ICCD 2021, ICPP 2021, HPCA 2021, ICPP 2020, HiPC 2020, VDAT 2020, ICCD 2019, *EMC*² 2018, IPDPS 2018, ICCD 2017
- PC member Nonlinearity, Information, and Robotics 2021

Past Selected Projects

Super Resolution Imaging on Reconfigurable Arrays, IIT Delhi (Jun 2015-May 2016)

Advisors: Prof. Kolin Paul and Prof. Anshul Kumar, IIT Delhi

- Implemented a Convolutional Neural Network on a Virtex-6 FPGA to convert an SD video to an HD video at real time.
- Optimizations include computation time reduction by exploiting inherent parallelism, efficient matrix multiplication by using Toeplitz representation and memory footprint reduction by using a rotating buffer instead of a full-size input buffer.
- Designed a self-defined protocol, partially exploiting the OCP protocol, to fetch image data in parallel from four DDR3 banks.

FPGA Cluster based Parallel Architecture for Cryptanalysis, BARC Mumbai

Advisor: Mr. Abhishek Bajpai, BARC Mumbai (May-Nov 2014)

- Developed a network of four Virtex-6 FPGAs that communicated via the MGT protocol.
- Developed Python and C wrappers for PCIe bus drivers to implement DMA from Linux Kernel Memory to FPGA BRAM space
- Presented paper at National Workshop on Cryptology 2014 (NWC).

Course Projects

- Implemented a distributed ledger of transactions using Google GO, IIT Delhi
- Designed a resource-constrained scheduling algorithm to maximize the performance in a system with multi-port memories, IIT Delhi
- Compared the impact of uniform and non-uniform caches on the performance of the processor, IIT Delhi
- Designed and fabricated a hand-held device to aid in sending flood alerts to the people and rescue location to the rescue team, IIITDM Jabalpur