CSE-PHD
ADMISSIONS

भारतीय सांकेतिक विज्ञान संस्था हैदराबाद
भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad

CSE DEPARTMENT HIGHLIGHTS

25 faculty members whose research interests span over areas of machine learning, data science, systems, networks, compilers, programming languages, theoretical computer science, etc.

Active academic partners such as University of Oxford, University of San Diego, University of Pittsburgh, University of Swinburne, IISc, IITs, IIITs, etc.

Faculty received sponsored research projects in the domains of cyber-physical systems, converged cloud radio access networks, 5G, Block chain, Systems for ML/AI, big data analytics, smart cities, formal verification, social networks analysis, visual intelligence, etc.

Strong publication record in tier-1 venues such as TOPLAS, VLDB, SIGMOD, POPL, KDD, CVPR, ICLR, ICML, SODA, STOC, JACM, IEEE TPAMI, IEEE TNNLS, IEEE TNSM, ACM SOSR, USENIX NSDI, etc.

Active research collaborations with various industry partners such as Microsoft Research India, IBM Research, Samsung Research India, Intel, AMD, INRIA, Suzuki, Eurocom.

HOW TO APPLY?

Applications must be submitted online at https://iith.ac.in/phdadmissions/

ELIGIBILITY

BE (or equivalent) with a valid GATE score, or students from a CFTI with a CGPA of 8.0 and above, or MTech degree holders can apply.

B.Tech (or equivalent) with a valid GATE score

B.Tech (or equivalent) from CFTI with CGPA 8.00 and above

MTech

PhD Programme
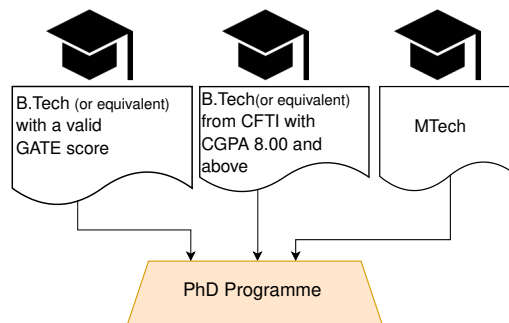
More details on PhD@CSE, IITH

- PhD Admissions and Eligibility: https://cse.iith.ac.in/admissions/phd.html
- Faculty: https://cse.iith.ac.in/people/faculty.html
- PhD Curriculum and guidelines
- For any further communication, write to: phd.admissions@cse.iith.ac.in

Antony Franklin

Associate Professor, Networked Wireless Systems Lab, CSE

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Major Areas of Research/Up to 3 major sponsored projects

1. Next Generation Mobile Networks (5G and Beyond)
2. Multi-Access Edge Computing
3. Cloud Radio Access Networks
4. SDN/NFV
5. V2X
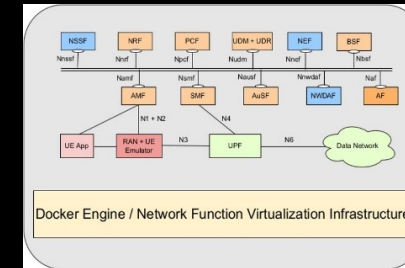
Major Research Facilities in the Group

1. IITH 5G Core Testbed with MEC support and RAN+UE Emulator
2. High end workstations and servers, whiebox switches, etc.
3. SDR Boards for 4G/5G RAN using OAI
4. V2X Development Boards

Technology/Product Developed/Up to 3 most significant Publications

1. IITH 5G Core with Support for MEC, Network Slicing, and Orchestration
2. S. Vittal and A. A. Franklin, "HARNESS: High Availability Supportive Self Reliant Network Slicing in 5G Networks," in IEEE Transactions on Network and Service Management, vol. 19, no. 3, pp. 1951-1964, Sept. 2022.
3. Shashwat Kumar, Sai Vineeth Doddala, A. Antony Franklin, Jiong Jin, RAN-aware adaptive video caching in multi-access edge computing networks, Journal of Network and Computer Applications, Volume 168, 2020
4. V. R. Chintapalli, S. B. Korrapati, B. R. Tamma and A. F. A, "NUMASFP: NUMA-Aware Dynamic Service Function Chain Placement in Multi-Core Servers," COMSNETS 2022, pp. 181-189. (Best Paper Award)

Bheemarjuna Reddy Tamma

Professor, Networked Wireless Systems (NeWS) Lab, Dept. of CSE

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Major Areas of Research

Wireless Networks, Network Security

Mobile Edge Computing, C-V2X, Quantum Internet

Major Research Facilities in the Group

Programmable 5G Cloud RAN testbed
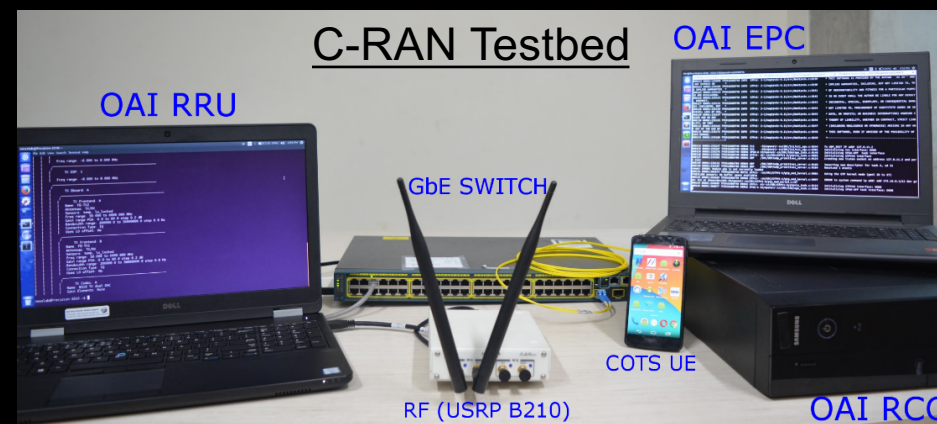
SDN Switches, USRP SDR boards

High-end Servers and workstations

Technology/Product Developed

LWIP: LTE-Wi-Fi Radio Level Interworking System

FENCE: Privacy-Preserving Enterprise Internet Forensics at Scale

Open source contributions on LWIP, Network Intrusion Detection using AI/ML, Intelligent energy saving in data centres using BMaaS under-cloud, and 5G SBA Core using SDN/NFV

C-RAN Testbed — OAI RRU, OAI EPC, GbE SWITCH, COTS UE, RF (USRP B210), OAI RCC

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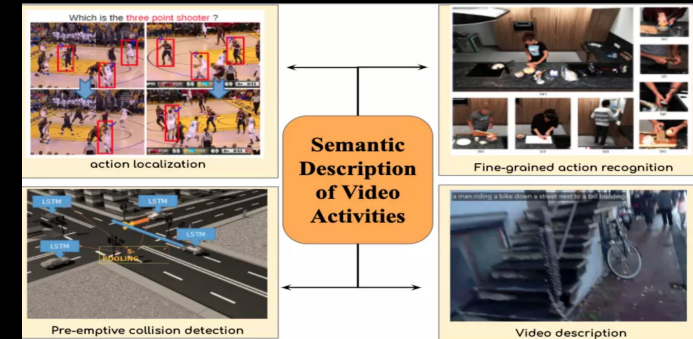Indian Institute of Technology Hyderabad

Major Areas of Research/Up to 3 major sponsored projects

- Action recognition, emotion recognition and video analytics
- Computer vision for autonomous vehicle technology
- Aerial imagery analysis and image/video captioning
- Medical imaging

Major Research Facilities in the Group

- Workstation consisting of four Nvidia A6000 GPU cards each with 48GB RAM.
- Three workstations each consisting of 32GB Nvidia Tesla series GPU cards.
- Four 24GB RAM Nvidia Quadro series GPU cards

Technology/Product Developed/Up to 3 most significant Publications

- Prudviraj Jeripothula, Chalavadi Vishnu, C Krishna Mohan, "AAP-MIT: Attentive Atrous Pyramid Network and Memory Incorporated Transformer for Multi-Sentence Video Description", IEEE Transactions on Image Processing, https://doi.org/10.1109/TIP.2022.3195643, 2022.
- Inayathullah Ghori, & Debaditya Roy, Renu John, and C Krishna Mohan, "Echocardiogram Analysis using Motion Profile Modeling," *IEEE Transactions on Medical Imaging*, vol. 39, no. 5, pp. 1767-1774, https://doi.org/10.1109/tmi.2019.2957290, 2019.
- Nazil Perveen, Debaditya Roy and C Krishna Mohan, "Facial Expression Recognition in Videos using Dynamic Kernels," IEEE Transactions on Image Processing, vol. 29, pp. 8316-8325, 10.1109/TIP.2020.3011846, 2020.

Dr. Sathya Peri

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Major Areas of Research

- Parallel & ConcurrentSystems
- Distributed Systems & Blockchains

Up to 3 major sponsored projects

- Parallelization of Smart Contract Execution in Tezos Blockchain
- Design and Development of a Unified Blockchain Framework for offering National Blockchain Service
- Concurrent and Distributed Programming primitives and algorithms for Temporal Graphs

Research Overview (Dr. Manish Singh, CSE IITH)

Research Interest: Social Network Analysis, Recommendation Systems, Healthcare Data Analysis, Information Extraction and Summarization, Bioinformatics

Datasets: Social Media, E-commerce, Community Question Answers, Healthcare

Research Overview

Social network analysis
- Enhance information diffusion: Factors such as network structure, posting time, post content
- Route questions to experts in CQA sites

Text mining
- Summarize social media posts
- Text classification: sentiment analysis, stance detection, arousal prediction, etc.
- Information extraction from text, such as extracting tags, product aspects, disease, medicine
- Product reviews exploration system

Recommendation systems
- Tag recommendation for product reviews, tweets, images, CQA posts
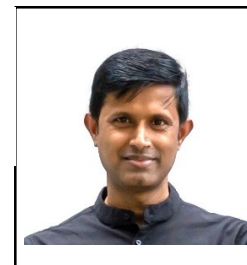- Site recommendation for research papers, CQA posts

Dr. Maunendra Sankar Desarkar

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## Major Areas of Research/Up to 3 major sponsored projects

Major areas of work: NLP, Recommendation Systems, Information Retrieval
Projects:
- Zero-shot Multi-lingual Personalized Auto-suggest Generation
- M2SMART SATREPS Project: Multimodal Regional Transport System - Smart Cities for Emerging Countries based on Sensing, Networking, and Big Data Analysis.

Major Research Facilities in the Group

Servers and GPU Powered workstations
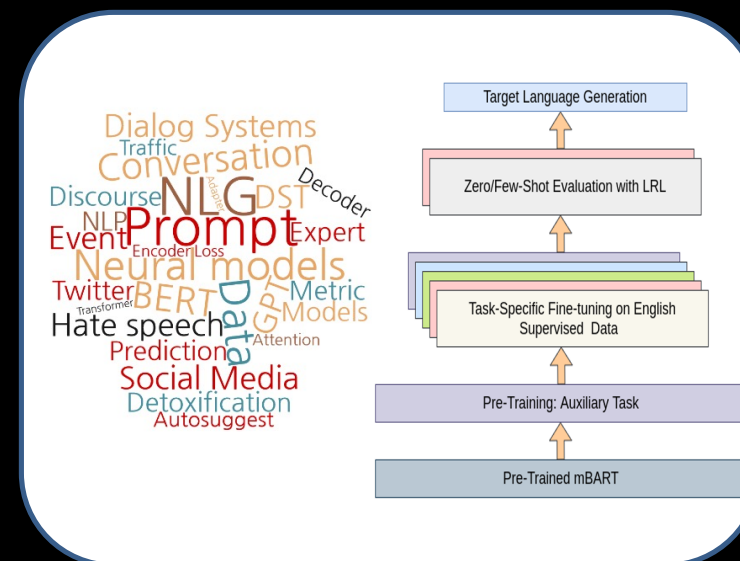
Technology/Product Developed/Up to 3 most significant Publications

- Kaushal Kumar Maurya, Maunendra Sankar Desarkar, Yoshinobu Kano, Kumari Deepshikha: ZmBART: An Unsupervised Cross-lingual Transfer Framework for Language Generation. ACL/IJCNLP (Findings) 2021: 2804-2818
- Suvodip Dey, Maunendra Sankar Desarkar: Hi-DST: A Hierarchical Approach for Scalable and Extensible Dialogue State Tracking. SIGDIAL 2021: 218-227
- Samujjwal Ghosh, Subhadeep Maji and Maunendra Sankar Desarkar, "Unsupervised Domain Adaptation With Global and Local Graph Neural Networks Under Limited Supervision and Its Application to Disaster Response," in IEEE Transactions on Computational Social Systems, doi: 10.1109/TCSS.2022.3159109.
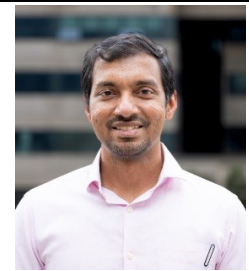
Rakesh Venkat

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Major Areas of Research

<u>Broad Area</u>: Theoretical Computer Science

Graph Partitioning, Communication Complexity, Approximation Algorithms, Quantum Computation

Selected Publications

A Refined Approximation for Euclidean k-Means (with F. Grandoni, R. Ostrovsky, Y. Rabani, L. Schulman), Information Processing Letters, 2022

Semi-random Graphs with Planted Sparse Vertex Cuts: Algorithms for Exact and Approximate Recovery. With A.Louis, ICALP 2019

Multiplayer Parallel Repetition for Expanding Games (with I. Dinur, P. Harsha, H. Yuen, ITCS 2017)

Dr. Nitin Saurabh

Asst Professor, Theoretical Computer Science, CSE
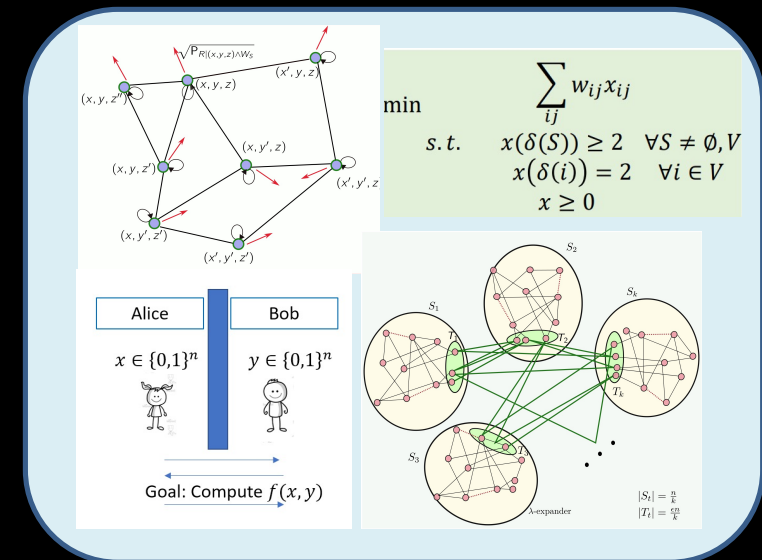
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Major Areas of Research/Up to 3 major sponsored projects

Theoretical Computer Science. In particular, Computational Complexity theory, especially Boolean and Algebraic complexity theory, Analysis of Boolean functions and Algorithms.

Technology/Product Developed/Up to 3 most significant Publications

1) Approximate Polymorphisms.
   G. Chase, Y. Filmus, D. Minzer, E. Mossel and N. Saurabh. In STOC 2022.
1) Improved Bounds on Fourier entropy and min-entropy.
   S. Arunachalam, S. Chakraborty, M. Koucky, N. Saurabh and R. de Wolf.
   In ACM TOCT 13, 2021.
1) Some Complete and Intermediate Polynomials in Algebraic Complexity Theory.
   M. Mahajan and N. Saurabh. In Theory of Computing Systems 62, 2018.

Dr. Shirshendu Das

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Major Areas of Research:

Most computer architecture innovations during the past 20 years have been based on the incorrect assumption that everything is innocent. A Side Channel or Covert Channel attack on such innovations can leak information and also degrades performance.

My research areas are:

- **Computer Architecture** - Designing efficient cache memories.
- **Hardware Security** - Making the multicore systems secure.
- **Emerging Memory Technologies** - Using alternate memory technologies to design cache memories.

Major Research Facilities:

- **Simulators Used:** gem5, Champsim, CACTI.
- **Modules available:** Tiled-based CMP (TCMP) with 2, 3, and 4 levels of cache memories, NVM support for Champsim, MESI CMP Protocol for 2, 3, and 4 levels of cache hierarchy, Covert Channel Attack (CCA) on TCMP.

Three most significant Publications:

1. Jaspinder Kaur and **Shirshendu Das**, "TPPD: Targeted Pseudo Partitioning based Defence for Cross-Core Covert Channel Attacks", *Elsevier Journal of System Architecture*, Accepted, December 2022.
2. Kaustav Goswami, Dip Sankar Banerjee and **Shirshendu Das**, "Towards Enhanced System Efficiency While Mitigating Row Hammer", *ACM Transactions on Architecture and Code Optimization (TACO)*, 18(4), December 2021.
3. Anurag Agarwal, Jaspinder Kaur and **Shirshendu Das**, "Exploiting Secrets by Leveraging Dynamic Cache Partitioning of Last Level Cache", *Design, Automation and Test in Europe Conference (DATE)* 2021.

Rameshwar Pratap

Assistant Professor, Computer Science & Engineering

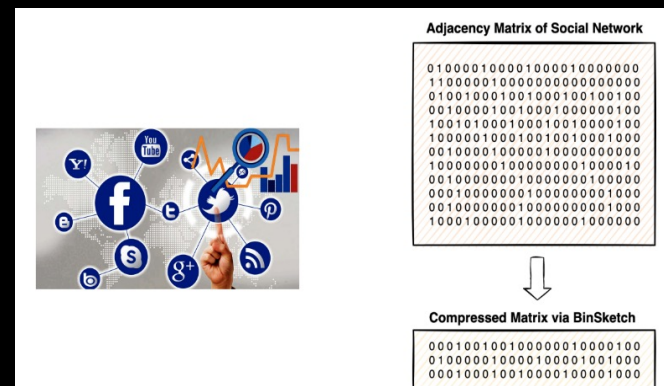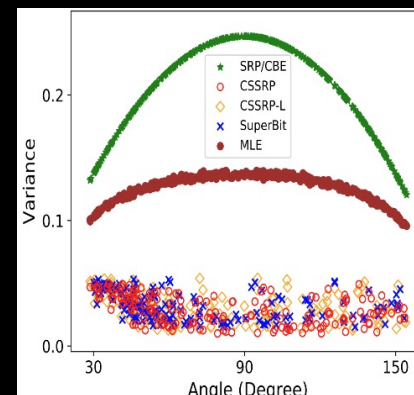rameshwar@cse.iith.ac.in; Rameshwar Pratap|IITH

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Major Areas of Research

1) Algorithm for Big Data

2) Sketching and Sampling Algorithms

3) Machine Learning

4) Theoretical Computer Science

Technology/Product Developed/Up to 3 most significant Publications

1) Dimensionality Reduction for Categorical Data. Debajyoti Bera, Rameshwar Pratap, and Bhisham Dev Verma. Accepted to the IEEE Transactions on Knowledge and Data Engineering (TKDE), 2021. (Paper link.)

2) Variance reduction in Feature Hashing using MLE and Control Variate Method. Bhisham Dev Verma, Rameshwar Pratap, and Manoj Thakur. In the Machine Learning, 2022. (Paper Link.)

3) Efficient Sketching Algorithm for Sparse Binary Data. Rameshwar Pratap, Debajyoti Bera, and Karthik Revanuru. In IEEE- ICDM (International Conferences of Data Mining), pages 508-517, 2019.

Praveen Tammana

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Major Areas of Research/Up to 3 major sponsored projects

Computer Networks and Systems

Network Security, Edge compute, Software-Defined Networks, P4

Major Research Facilities in the Group

IoT devices connected to P4/SDN/Servers

Kubernetes cluster for observability

Software-Defined Networking testbed
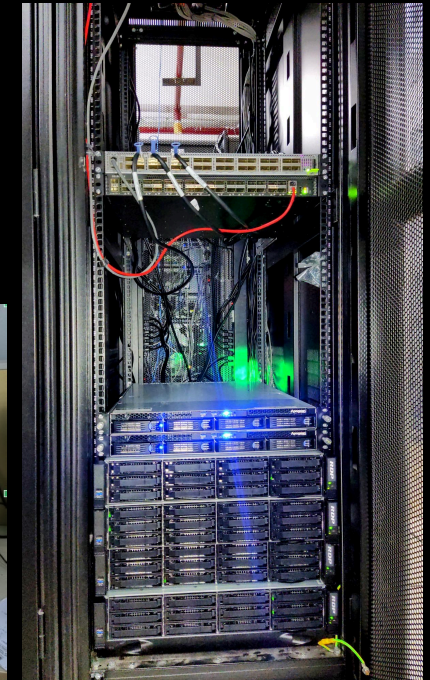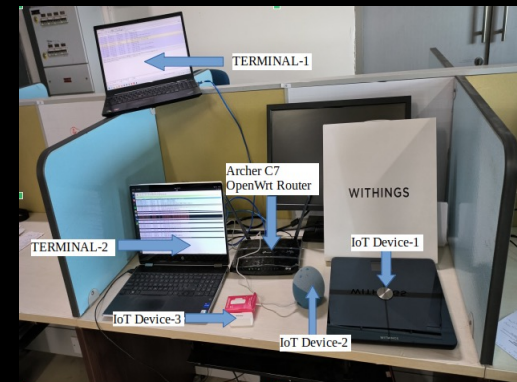
Technology/Product Developed/Up to 3 most significant Publications

PUF-based Authentication Protocol for IoT Security
IoT-MUD enforcement to secure L3/L4 communication
Efficient Intrusion detection system
Edge Cloud for Autonomous Navigation Applications
Validation of packet-processing behavior at a P4 switch

Srijith P K
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## Major Areas of Research/Up to 3 major sponsored projects

Machine learning, Deep Learning, Bayesian learning, Continual Learning.

Applications : Computer Vision, natural language processing and social media.

Publications in top venues like NeurIPS, AAAI, WACV, ACL, EMNLP, UAI etc.

Major Research Facilities in the Group

Expertise in machine learning , deep learning, vision, language, social media, generative modelling and spatio- temporal modelling.

GPU servers and access to the state-of-the-art NVIDIA DGX servers.
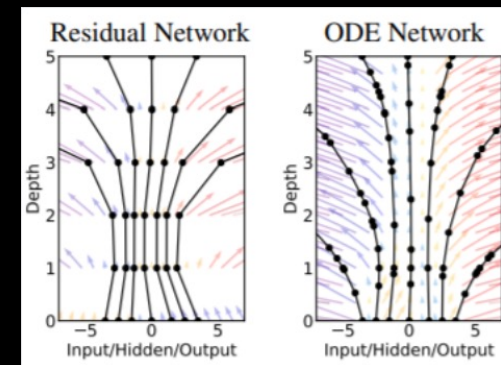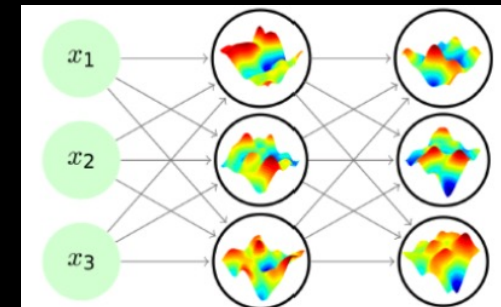
Technology/Product Developed/Up to 3 most significant Publications

1.Srikar Dupati, Sakshi Varshney, P.K. Srijith, Sunil, Gupta, Continual Learning with Dependency Preserving Hypernetworks, IEEE/CVF Winter Conference on Applications of Computer Vision (WACV) 2023.
2. Srinivas Anumasa and P. K. Srijith, Latent Time Neural Ordinary Differential Equations, Proceedings of the Association for the Advancement of Artificial Intelligence (AAAI), 2022.
3. Sakshi Varshney, Vinay Kumar Verma, P. K. Srijith, Lawrence Carin, Piyush Rai: CAM-GAN: Continual Adaptation Modules for Generative Adversarial Networks, Neural Information Processing Systems, 2021.
4. Developed a real time social media system to aid people in disaster like floods and earthquakes.

Maria Francis

Assistant Professor, Computer Science & Engineering

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Major Areas of Research

- Privacy preserving mechanisms over blockchains
- Lightweight cryptography for IoT
- Lattice-based cryptography
- Computational algebra

Major Research Facilities in the Group

Our work focuses mainly on theoretical results and prototype implementations which do not require any special facilities.
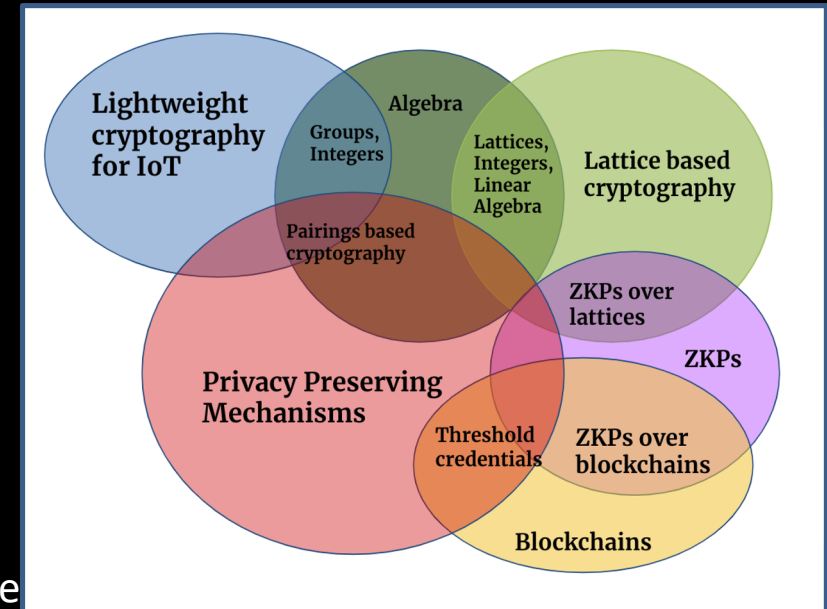
Technology/Product Developed/Up to 3 most significant Publications

1. A. Naaz, T. V. Pavan Kumar B, M. Francis and K. Kataoka, "Integrating Threshold Opening With Threshold Issuance of Anonymous Credentials Over Blockchains for a Multi-Certifier Communication Model," in IEEE Access, vol. 10, pp. 128697-128720, 2022.
2. M. Francis and T. Verron. "On Two Signature Variants Of Buchberger's Algorithm Over Principal Ideal Domains", International Symposium on Symbolic and Algebraic Computation (ISSAC) 2021.
3. M. Francis and A. Dukkipati. "On Ideal Lattices, Gröbner Bases and Generalized Hash Functions", Journal of Algebra and its Applications, Vol. 17, No. 06, 1850112 (2018).

Vineeth N Balasubramanian

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Major Areas of Research:

- Machine Learning/Deep Learning
- Computer Vision
- Explainable AI
- Causal Inference

Major Research Facilities in the Group:

- NVIDIA DGX1/DGX2s
- Multiple GPU servers with 1080Ti/2080Tis
- GPU workstations

Technology/Product Developed/Up to 3 most significant Publications

- **Explainable AI:** Grad-CAM++, WACV 2018 (1300+ citations), NASSCOM AI Gamechanger Runner-up 2022
- **Learning with Limited Labeled Data:** Open-world Object Detection, CVPR 2021 (~150 citations, ~900 stars, ~140 forks), NASSCOM AI Gamechanger Winner 2022
- **Causality:** Causal Perspective to Neural Network Attributions, ICML 2019 (~100 citations, ~50 stars, ~20 forks)

Rajesh Kedia

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Major Areas of Research/Up to 3 major sponsored projects

1. Computer architecture

2. Embedded systems

3. VLSI design automation

Major Research Facilities in the Group

1. ZCU102 board

2. Versal ACAP (VCK190) board
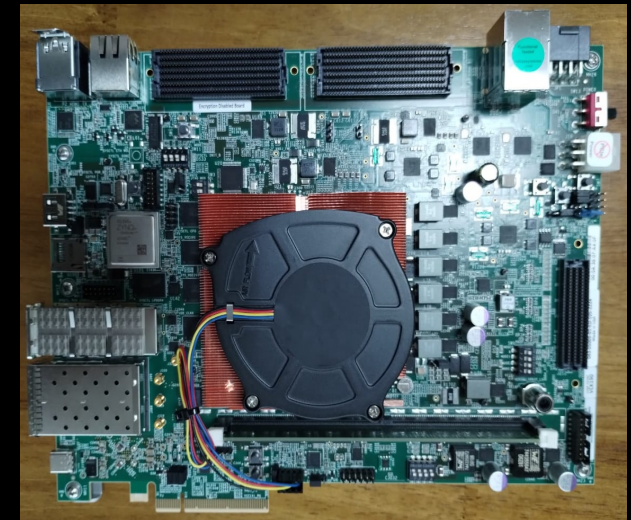
Technology/Product Developed/Up to 3 most significant Publications

1. CoMeT – Open source architectural and thermal simulator, TACO 2022

2. DSE of FPGA based system with DNN Accelerators, IEEE ESL 2021

3. CoreMemDTM: Thermal management for processor and 3D memory, DATE 2022

Rogers Mathew

Associate Professor, TCS, Department of CSE

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Major Areas of Research

1. Combinatorics

2. Graph Theory

3. Graph Algorithms

Major Research Facilities in the Group

Nil. The work is fully mathematical in nature that needs only pen and paper.

Three Most Significant Publications

1. Sriram Bhyravarapu, Subrahmanyam Kalyanasundaram, Rogers Mathew: A short note on conflict-free coloring on closed neighborhoods of bounded degree graphs. J. Graph Theory 97(4): 553-556 (2021)

2. Rogers Mathew, Ilan Newman, Yuri Rabinovich, Deepak Rajendraprasad: Hamiltonian and pseudo-Hamiltonian cycles and fillings in simplicial complexes. J. Comb. Theory, Ser. B 150: 119-143 (2021)

3. Rogers Mathew, Tapas Kumar Mishra, Ritabrata Ray, Shashank Srivastava: Modular and Fractional L-Intersecting Families of Vector Spaces. Electron. J. Comb. 29(1) (2022)

A short note on conflict-free coloring on closed neighborhoods of bounded degree graphs

Sriram Bhyravarapu | Subrahmanyam Kalyanasundaram | Rogers Mathew

Department of Computer Science and Engineering, Indian Institute of Technology Hyderabad, Hyderabad, India

Correspondence
Rogers Mathew, Department of Computer Science and Engineering, Indian Institute of Technology Hyderabad, Hyderabad 502285, India.
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Abstract
The *closed neighborhood conflict-free chromatic number* of a graph G, denoted by $\chi_{CN}(G)$, is the minimum number of colors required to color the vertices of G such that for every vertex, there is a color that appears exactly once in its closed neighborhood. Pach and Tardos showed that $\chi_{CN}(G) = O(\log^{2+\varepsilon}\Delta)$, for any $\varepsilon > 0$, where Δ is the maximum degree. In 2014, Glebov et al. showed existence of graphs G with $\chi_{CN}(G) = \Omega(\log^2\Delta)$. In this article, we bridge the gap between the two bounds by showing that $\chi_{CN}(G) = O(\log^2\Delta)$.

KEYWORDS
bounded degree graphs, conflict-free coloring

1 | INTRODUCTION

Conflict-free coloring was introduced [2] in 2003 motivated by problems arising from situations in wireless communication. Over the past two decades, conflict-free coloring has been extensively studied [6].

Definition 1 (Conflict-free chromatic number of hypergraphs). The *conflict-free chromatic number* of a hypergraph $H = (V, E)$ is the minimum number of colors required to color the points in V such that every $e \in E$ contains a point whose color is distinct from that of every other point in e.

Conflict-free coloring has also been studied in the context of hypergraphs created out of simple graphs. Two such variants are *conflict-free coloring on closed neighborhoods* and *conflict-free coloring on open neighborhoods*. In this note, we focus on the former variant. For any vertex

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भारतीय सांकेतिक विज्ञान संस्थ हैदराबाद
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Indian Institute of Technology Hyderabad

Major Areas of Research:

Parameterized Algorithms, Random Graphs, Graph coloring

Major Research Facilities in the Group:
N/A

3 most significant Publications:

Dichotomy Results on the Hardness of H-free Edge Modification problems, SIAM J. Disc Math, 2017

On Polynomial Kernelization of H-free Edge Deletion, Algorithmica, 2017

An FPT Algorithm for Matching Cut and d-Cut, IWOCA 2021

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Major Areas of Research/Up to 3 major sponsored projects

Parameterized Algorithms and Complexity

Approximation Algorithms

Streaming Algorithms

Major Research Facilities in the Group

GPU Workstation with NVIDIA A6000

Three most significant Publications

1. **Deleting, Eliminating and Decomposing to Hereditary Classes Are All FPT-Equivalent.**
   In SODA 2022. With A. Agrawal, L. Kanesh, D. Lokshtanov, M.S. Ramanujan, S. Saurabh, M. Zehavi.

2. **Lossy kernelization.**
   In STOC 2017. With D. Lokshtanov, M.S. Ramanujan, S. Saurabh.

3. **Efficient Computation of Representative Families with Applications in Parameterized and Exact Algorithms.**
   In JACM 2016. With F. V. Fomin, D. Lokshtanov, S. Saurabh.
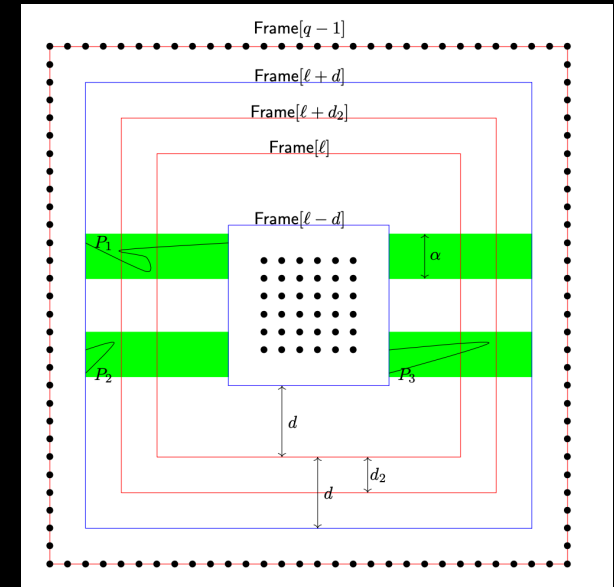
M. V. Panduranga Rao

Associate Professor, CSE

Quantum Computing and Communications
Formal Methods: Theory and Applications
Algorithms and Complexity

Model Checking for Entanglement Swapping

Surya Sai Teja Desu, Anubhav Srivastava & M. V. Panduranga Rao ✉

Abstract

Entanglement swapping is a basic primitive in long distance quantum communications. The stochastic nature of various operations like entanglement generation and BSMs makes the entanglement swapping primitive failure prone. It is difficult to predict whether or not an entanglement swapping operation will succeed within a stipulated time. In this paper, we use Probabilistic Timed Automata (PTA) to model the experiment and analyze it through model checking. We report a proof-of-concept mechanism, opening way for the analysis of large scale quantum networks through formal methods. We also report supporting results on a quantum simulator.

Keywords

Entanglement Swapping   Quantum Networks   Probabilistic Timed Automata

Quantum Network Simulators

Recent Papers (2022):

1. **Statistical Model Checking for Probabilistic Temporal Epistemic Logics.** ICAART (1) 2022: 53-63 (with Yenda Ramesh)
2. **Model Checking for Entanglement Swapping.** FORMATS 2022: 98-114, with Surya Sai Teja Desu, Anubhav Srivastava
1. **Quantum learning of concentrated Boolean functions.** Quantum Inf. Process. 21(7): 256 (with Krishna Palem and Duc Hung Pham,

Subrahmanyam Kalyanasundaram

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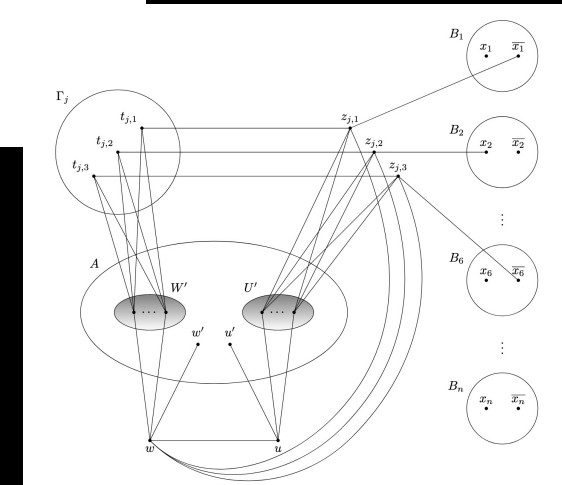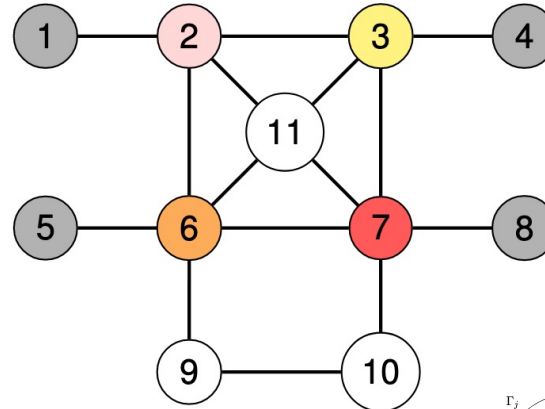
Major Areas of Research

- Theoretical Computer Science
- Combinatorics
- Graph Algorithms

Major Research Facilities in the Group

Theoretical research without much need for major facilities

Selected Publications

- Sriram Bhyravarapu, Subrahmanyam Kalyanasundaram, Rogers Mathew (2022). Conflict-Free Coloring Bounds on Open Neighborhoods. Algorithmica, Volume 84, pages 2154-2185.
- Prasad Krishnan, Rogers Mathew, Subrahmanyam Kalyanasundaram (2021). Pliable Index Coding via Conflict-Free Colorings of Hypergraphs. Proc. of the 2021 IEEE International Symposium on Information Theory - ISIT 2021, Melbourne, Australia.

Jyothi Vedurada

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Major Areas of Research/Up to 3 major sponsored projects

1. Towards High Programmer Productivity Using AI and Program Analysis (Funded by Microsoft Research + Seed grant)
2. Compiler Optimizations for GPU programs
3. High-performant Large-scale Graph Algorithms on GPUs

Major Research Facilities in the Group

1. Server Node with 2 x Nvidia A100 40GB GPU cards and dual CPU Processor, each with 16C
2. Server Node with dual CPU processor, each with 16C
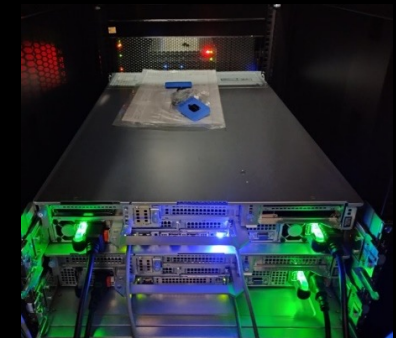
Technology/Product Developed/Up to 3 most significant Publications

1. Tool for Automatic Code Comprehension of Data Science Notebooks
2. LLVM Compiler Implementation for GSOHC: Global Synchronization Optimization in Heterogeneous Computing

Karteek Sreenivasaiah

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Areas of Research

Computational Complexity
Algorithms
Theoretical Computer Science

Research Interests

My interests lie broadly in the area of *Theory of Computation*, and in particular, *Computational Complexity*. My research involves studying various models of computation to understand their computational power and in turn, understand the role that different resources play in computation. The models that I study typically involve *circuits*.

Selected Publications

Nutan Limaye, Karteek Sreenivasaiah, Srikanth Srinivasan, Utkarsh Tripathi, S. Venkitesh: *A Fixed-Depth Size-Hierarchy Theorem for AC0^{+} via the Coin Problem*. SIAM J. Comput. 50(4): 1461-1499 (2021)

Christian Ikenmeyer, Balagopal Komarath, Christoph Lenzen, Vladimir Lysikov, Andrey Mokhov, Karteek Sreenivasaiah: *On the Complexity of Hazard-free Circuits*. J. ACM 66(4): 25:1-25:20 (2019)