Rajrup Ghosh

Doctoral Student in Computer Science

USC Networked Systems Laboratory (NSL), SAL Computer Science Center, Los Angeles, CA - 90089, USA

rajrupgh@usc.edu | nsl.usc.edu/people/rajrup-ghosh | rajrup-ghosh | Rajrup | rajrup-ghosh | @rajrup_tweets

Education

University of Southern California (USC)

Los Angeles, USA

Ph.D. in Computer Science

2019 - present

- **GPA:** 4.0/4.0
- **Position:** Research Assistant in **Networked Systems Laboratory (NSL), USC**
- **Advisor:** **Prof. Ramesh Govindan**

Indian Institute of Science (IISc)

Bangalore, India

M.TECH. in Computational Science

2015 - 2017

- **GPA:** 6.8/8.0, Gold Medalist

Indian Institute of Engineering Science and Technology (IIEST)

Shibpur, India

B.E. in Computer Science and Technology

2011 - 2015

- **GPA:** 9.28/10.00

Projects

Immersive Video Project [NSL]

USC, Los Angeles

Volumetric Video Streaming

Oct 2020 - present

- ***6DoF Video*:**
  - Volumetric videos capture 3D scenes in six degrees of freedom (6DoF), given by position and color information of the scene.
  - Developing an end-to-end pipeline consisting of live **stereo capture**, **registration**, **compression**, and **live streaming** to user devices.
  - Multiple Azure **Kinect cameras** deployed in an indoor environment capturing **point clouds** at 30 fps.
  - **Challenges:** Fast compression, Bit-rate Adaptation, Low Latency, Real-time Decompression, Realistic Rendering.
- ***6DoF Audio*:**
  - Capture audio from multiple **Ambisonic** or **Lavalier** microphones.
  - Track audio sources in the volumetric capture for accurate localization.
  - Generate spatial audio using **Head-related Transfer Functions (HRTFs)** from the localized sources relative to the user.
- **Applications**: Telepresence, Virtual Classroom, Collaborative Workspace, Telemedicine, AR/VR Multiplayer Gaming.
- This project is a part of **NSF Grant – Multi-perspective Video**.

Drone Project [NSL]

USC, Los Angeles

LIDAR-based Fast 3D Reconstruction using Drone

June 2021 - Dec 2021

- Capture **3D structures** like buildings, airplanes using a drone mounted **LIDAR** in the form of **point clouds**.
- Efficient trajectory planning for the drone to maximize the quality of reconstruction while minimizing battery usage.
- Offload heavy computation such as localization using SLAM and point cloud registration using ICP to the **Cloud**.
- Requires fast **point cloud compression** at different compression ratios depending on bandwidth.
- This work is under *review*.

CONIX Project [NSL]

USC, Los Angeles

Accelerating Deep Neural Network Inference

Jan 2020 - May 2021

- ***Scrooge*:**
  - A framework for scheduling data-dependent **DNN** workloads on **Cloud Clusters** that satisfy application SLOs, while minimizing VM cost.
  - Published in *ACM SoCC 2021* [Paper].
- ***RIM*:**
  - A framework for placing **DNN** applications on **Edge Clusters** that satisfy throughput and latency, while achieving high GPU utilization.
  - Published in *IoTDI 2021* [Paper].
- These projects are part of **CONIX Research Center**.

Masters Thesis [DREAM:Lab]

IISc, Bangalore

Distributed Scheduling of Event Analytics across Edge and Cloud — *Jan 2016 - June 2017*

- The thesis focused on efficient static and dynamic **scheduling** of distributed run-time query plans for complex event processing.
- Designed **algorithms** to map user queries on heterogeneous resources such as **Edge devices** (Raspberry Pi) and **Cloud VMs** (Azure) to meet constraints like compute latency, network bandwidth, and energy capacity of the resources.
- Published in *ACM TCPS 2018* [Journal] and *CCGRID 2018* [Conference Paper].
- This project was a part of **IISc Smart Campus Project**.

Undergraduate Thesis

IIEST, Shibpur

Implementation of a navigation scheme for a UAV employed to measure air quality — *June 2014 - May 2015*

- Proposed a novel **dispersion model** for air pollutants (particularly, aerosols) that can help in estimating pollution concentration at different scales for a geographical region.
- Measurement of air quality parameters using our designed **quad-copter** around Shibpur Industrial Area, West Bengal, India.
- This project was in collaboration with **West Bengal Pollution Control Board**.

Selected Publications

Fresco: Fast, High-quality 3D Reconstruction

Submitted

F. Ahmad, C. Shin, **R. Ghosh**, J. D'Ambrosio, E. Chai, K. Sundaresan, R. Govindan — *Dec 2021*

- Under Review

Scrooge: A Cost-Effective Deep Learning Inference System

SoCC

Y. Hu, **R. Ghosh**, R. Govindan — *1-3 Nov 2021*

- SoCC 2021 - 12th ACM Symposium on Cloud Computing, **URL:** Paper

Rim: Offloading Inference to the Edge

IoTDI

Y. Hu, W. Pang, X. Liu, **R. Ghosh**, B. Ko, W. Lee, R. Govindan — *18-21 May 2021*

- IoTDI 2021 - 6th ACM/IEEE Conference on Internet of Things Design and Implementation, **URL:** Paper

Adaptive Energy-Aware Scheduling of Dynamic Event Analytics across Edge and Cloud Resources

CCGRID

R. Ghosh, S. P. R. Komma, Y. Simmhan — *1-4 May 2018*

- CCGRID 2018 - 18th IEEE/ACM International Symposium on Cluster, Cloud and Grid Computing, **URL:** Paper

Distributed Scheduling of Event Analytics across Edge and Cloud

ACM TCPS

R. Ghosh, Y. Simmhan — *Sep 2018*

- ACM Transactions on Cyber-Physical Systems (TCPS), **URL:** Article

Experiences

DMX Group, Microsoft Research

Microsoft Research, Redmond

Research Internship - Krishna Chintalapudi — *June 2020 - Aug 2020*

- Greedy layer-by-layer neural network training for tasks such as image classification, detection, and segmentation. (Ongoing)
- Developed segmentation-based **person tracking** using body parts-based re-identification.
- Conceptualized **automated model training** for machine learning systems deployed in production pipelines.

Advanced Technology Lab, Samsung R&D Institute India

Samsung R&D Institute India

Lead Engineer (Research Position) — *July 2017 - July 2019*

- Built **on-device Neural Network**-based solutions for smartphone keyboard applications like Swipe, Auto-correct and Emoji Prediction.
- Developed applications over **Blockchain** - User Authentication System for smart building and peer-to-peer payment system.
- Developed an **IoT Query Engine** to perform data fusion on home appliance data stored across different SQL and NoSQL datastores.

Crypto Research Lab, IIT Kharagpur

IIT Kharagpur

Summer Internship - Prof. Dipanwita Roy Chowdhury — *Sum. 2013, Sum. 2014*

- Cryptanalysis of a light-weight hash function PHOTON using **fault-based attack** technique similar to Diagonal Faults for AES. A similar technique was applied for a SHA-3 Finalist hash function GROSTL.
- Studied the design and cryptanalysis of SHA-3 standard Keccak Hash Function for reduced round attacks.

Achievements

2019 - Pres. Received **Annenberg Fellowship** for outstanding Ph.D. student joining in Fall 2019.
June 2018 Received **Motorola Gold Medal** for best performance in Master's degree in both academic courses and thesis.
June 2016 **Second** in Microsoft Research IoT Summer School hackathon on innovative IoT applications/projects.
2015 - Pres. Participated in Google APAC 2017 (Best Rank - 412), ACM ICPC 2015.
Jan 2015 Received **INAE (Indian National Academy of Engineering) Fellowship** for performance in internship under an INAE Fellow.

Skills

Programming: C, C++, Python, Java, Golang
Frameworks/Platforms: Point Cloud Library (PCL), CARLA, Unity, Tensorflow, PyTorch, CUDA, MPI, OpenMP, OpenCV, Arduino
Development Tools: Visual Studio, Android Studio, Eclipse
Databases: Oracle, MySQL, MongoDB

Interests

Research: Immersive Video, AR/VR Video Streaming, Video Delivery, Systems for ML, Edge Computing, Cloud Computing
Personal: Music, Trekking, Cycling

Seasoned Courses

Systems: Operating Systems, Computer Networks, Distributed Systems, High Performance Computing, Parallel Programming
ML: Artificial Intelligence, Data Analytics, Data Analysis and Visualization
Basic: Design and Analysis of Algorithms, Probability & Statistics, Numerical Linear Algebra, Numerical Methods

Mentorship

USC, Los Angeles
May 2021 - present

Volumetric Video

- Jonathan Liu - Undergraduate, *Viterbi Research Fellow*
- Owen Mech - Undergraduate, *Viterbi Research Fellow*

Spatial Audio

- Emily Kuo - *Undergraduate Thesis*
- Matt Baseheart - Masters

Autonomous Driving

- Tanvi Deshpande - SHINE Outreach High School Student