

Deepak Choudhary Lalith

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Research Interests: Computer Networking, Systems, and Network Security.

Education

Aalto University, Finland M.Sc., Computer, Communication, and Information Sciences Major: Communication Engineering	2024 - 2026
REVA University, India B.Tech., Electronics and Communication Engineering GPA: 9.10/10 , top 5% of the class	2017 - 2021

Research Experience

Indian Institute of Science (IISc) Centre for Networked Intelligence [🌐] <i>Research Assistant</i> Advisors: Dr. T. V. Prabhakar and Dr. Chandramani Singh Projects: Time-Sensitive Networking (TSN), Tactile Cyber-Physical Systems (TCPS)	Feb 2022 - July 2024
Delft University of Technology <i>Research Collaborator</i> Advisors: Dr. RR Venkatesha Prasad and Dr. T. V. Prabhakar Project: Intercontinental haptic bilateral teleoperation	June 2023 - Nov 2023

Publications

Towards a TSN-DetNet Intercity Testbed for Tactile Cyber-Physical Systems [🌐] Joydeep Pal, Deepak Choudhary* , Nithish Gnani*, T.V.Prabhakar, Chandramani Singh, Hari Krishna Atluri, A. Paventhan <i>IEEE International Conference on Computer Communications Workshops (INFOCOM) 2024</i>	[IEEE INFOCOM '24]
EdgeP4: In-Network Edge Intelligence for a Tactile Cyber-Physical System Testbed Across Cities [🌐] Nithish Gnani, Joydeep Pal, Deepak Choudhary , Himanshu Verma, S. Rana, K. Mhapsekar, T.V.Prabhakar, Chandramani Singh <i>IEEE International Conference on Computer Communications Workshops (INFOCOM) 2024</i>	[IEEE INFOCOM '24]
Enhancing Reliability of Scheduled Traffic in Time-Sensitive Networks using Frame Replication and Elimination [🌐] Soumya Kanta Rana, Himanshu Verma, Joydeep Pal, Deepak Choudhary , T.V.Prabhakar, Chandramani Singh <i>IEEE International Symposium on Local and Metropolitan Area Networks</i>	[IEEE LANMAN '23]
μTAS: Design and implementation of Time Aware Shaper on SmartNICs to achieve bounded latency [🌐] Joydeep Pal, Deepak Choudhary , Nithish Gnani, Chandramani Singh, T.V.Prabhakar <i>Under Submission</i>	[arXiv pre-print]
DIA: Tactile Internet at a distance H.J.C. Kroep, Deepak Choudhary , R.R.Venkatesha Prasad, T.V.Prabhakar <i>Under Submission</i>	

Talks and Presentations

"[Demo] Designing Tactile Cyber-Physical Systems"	
> ITU Workshop	May 2023 (IISc)
> IISc Open Day	March 2023, February 2024 (IISc)
> 6th Annual Symposium on Cyber-Physical Systems (CyPhySS)	July 2022 (IISc)
> Digital India Week	July 2022 (Gandhinagar, Gujarat)
"Achieving Bounded latency for Time-Sensitive Applications"	
> Cisco-IISc Day	November 2022 (IISc)
> IBM-IISc Research Day [🌐]	September 2022 (IISc)

Teaching Responsibilities

- Teaching Assistant, TCP/IP Networking Indian Institute of Science Fall 2023
- > A graduate TCP/IP Networking core course offered at DESE, IISc by Prof. T. V. Prabhakar and Prof. Joy Kuri.
- > Responsibilities include designing lab exercises every week, grading assignments, and resolving student doubts.
- Instructor NSE TalentSprint 5G Cohort 2023 - 2024
- > Conducted three hands-on workshops to teach data-plane programming using P4.
- > Responsibilities included setting up a P4-programming environment using Mininet, providing in-depth explanations of programmable switch architecture, creating custom protocols and topology, and solving P4 exercises.

Selected Research Projects

- EdgeP4: A P4-Programmable Edge Intelligent Ethernet Switch for TCPS 2023 - 2024
- Built a TCPS testbed to demonstrate teleoperation for real-time interaction between humans and robots.
- > Developed and implemented edge intelligence algorithms for teleoperation, pose correction, and tremor suppression on a P4-programmable edge switch.
- > Reduces control loop latency (<100 μ s for pose correction task) and network load (up to 99% reduction).
- > Developed pose correction algorithm to automatically adjust a robot’s pose while gripping a tool for real-time precision control.
- > Developed a tremor-suppression algorithm on the edge switch that suppresses tremors in the robot arm while controlling it using a haptic device.
- > Work published at IEEE INFOCOM CNERT Workshop 2024 and secured Best Paper Award.
- μ TAS: Achieving bounded latency for time-sensitive applications 2022 - 2024
- > Implemented a time-slotted scheduling mechanism on programmable smartNICs.
- > Achieved bounded latency of 20 μ s for the scheduled traffic (ST) in the presence of best effort (BE) traffic.
- > Demonstrated the algorithm across a physical testbed of two end-hosts connected via two switches.
- > The bounded latency is 20x lower compared to the Linux kernel-based implementation of Time Aware Shaper (TAS) i.e. Linux tc TAPRIO.
- DIA: Tactile Internet at a distance [🔗] June '23 - Nov '23
- In collaboration with TU Delft. Advisors: T. V. Prabhakar, RR Venkatesha Prasad
- > Enabled intercontinental teleoperation of a robotic arm (at IISc) from a haptic device (at TU Delft) with haptic feedback over the internet.
- > Initiated large-scale network measurements to characterize jitter, latency, and network paths to understand their effects on the operator’s experience.

- P4-Netronome Workflow Setup & Testing 2022
- > Carried out the hardware, software, and network topology setup from scratch to compile, deploy, and test P4 programs on Netronome SmartNIC.
- > Established a network topology of workstations equipped with Netronome SmartNICs to successfully test the In-Band Network Telemetry (INT) and custom-scheduling P4 programs.
- > Automated compiling and testing P4 programs with Python and bash scripts.
- > Performed extensive latency measurements with the topology to design deterministic scheduling algorithms.

Skills

Languages	C, C++, Python, P4, HTML, CSS
Networking	Netronome (NFP), Scapy, Mininet, iPerf, bmv2 software switch, ns3
Technology and Tools	Linux, Git, Bash, ftrace, KVM-QEMU, Oracle VirtualBox, \LaTeX
Frameworks	Flask, Bootstrap

Awards

- Finland Scholarship 2024 - 2026 Awarded for Master’s studies at Aalto University
- Best Paper Award [🔗] IEEE INFOCOM CNERT Workshop 2024
- Institute Merit Scholarship | REVA University Awarded for being in the top 5% of the batch (Batch size: 376)
- Academic Excellence Award Top 3 in the class every year from Grade III to X