P. N. Karthik

Personal Data

Date of Birth:	20 Apr 1992
Address:	06-12, Block E4, Engineering Drive 3, National University of Singapore, 117583
Phone:	+65 80432990
Email:	pnkarthik1992@gmail.com (personal), karthik@nus.edu.sg (official)
Website:	https://karthikpn.com
LinkedIn:	https://www.linkedin.com/in/pnkarthik/
Google Scholar:	https://scholar.google.com/citations?user=D39u7bkAAAAJ&hl=en&authuser=1

Research Interests

Multi-armed bandits, statistical learning, federated learning, transfer learning, information theory, sequential analysis, hypothesis testing, Markov decision processes, anomaly detection, stochastic adaptive control

Experience

Jan'22 - present **Research Fellow**
Institute of Data Science, National University of Singapore (NUS), Singapore
Supervisor: Prof. Vincent Y. F. Tan
- Characterising the performance limits of multi-armed bandit algorithms for federated learning, transfer learning, best arm identification, etc.
- Fostering collaborative ties between NUS and other prominent institutes such as IIT Madras (IITM), IIT Bombay (IITB), Rensselaer Polytechnic Institute (RPI), Technion
- Assisting Ph.D. students and their supervisors at NUS and IITM, and contributing to the successful completion of Ph.D. research projects

May'23 - Jun'23 **Visiting Researcher**
Technion Israel Institute of Technology, Haifa, Israel
Host: Prof. Nir Weinberger

Nov'19 - Mar'20 **Research Intern**
Netradyne Technology India Pvt. Ltd., Bengaluru (in collaboration with the Bengaluru Metropolitan Transport Corporation (BMTC))
- Studied the effectiveness of the bus priority lane (BPL) in Bengaluru based on travel times of public transport buses and driver stress levels
- Proposed a novel technique for extracting travel times from GPS data
- Reported that the BPL reduced the worst 10% of the travel times by 4-28%
- Reported that the drivers were most stressed during the morning peak hours

Aug'19 - Dec'19
Aug'18 - Dec'18
Aug'17 - Dec'17 **Graduate Teaching Assistant**
Department of ECE, Indian Institute of Science, Bengaluru
Courses: Information Theory (E2 201), Random Processes (E2 202)
Instructors: Prof. Himanshu Tyagi, Prof. Utpal Mukherji, Prof. Parimal Parag
- Taught a class of 83 students (weekly, 1.5 hours per week)
- Evaluated students' answer scripts (weekly assignments)
- Assisted the instructors in formulating questions for exams & assignments

Aug'14 - Jun'15 **Project Assistant**
Department of ECE, Indian Institute of Science, Bengaluru
Supervisor: Prof. Chandra R. Murthy
- Characterised the area coverage uncertainty in a network of access points
- Validated the results with the data collected from access points at a hospital
- Presented the results to the Aerospace Network Research Consortium

Education

Jul'15 - Mar'22 **Doctor of Philosophy and Master of Science (Engineering)**,
Indian Institute of Science, Bengaluru
Department: Electrical Communication Engineering
Thesis: Sequential Controlled Sensing to Detect an Anomalous Process
Supervisor: Prof. Rajesh Sundaresan
GPA: 7.0/8.0

Aug'10 - Jul'14 **Bachelor of Engineering,**
R V College of Engineering, Bengaluru
Major: Electronics and Communications
GPA: 9.72/10.00 (rank 2 among 140 students)

Awards and Honors

- First place in the 100 seconds competition organised by INAE Kanpur Chapter
- Best paper award at the 2020 EECS Research Students' Symposium, Indian Institute of Science
- Best 3-minute presentation, ECE Students' Seminar Series, Department of ECE, Indian Institute of Science
- Rank 136 (among the top 0.01%) in the 2015 Graduate Aptitude Test in Engineering
- Infineon India scholarship for securing rank 2 in the 2011 Visvesvaraya Technological University examinations.
- Rank 23 (among the top 0.02%) in the 2010 Karnataka Common Entrance Test

Publications

Preprints

1. *Federated Best Arm Identification with Heterogeneous Clients* arxiv
   Chen Zhirui, P. N. Karthik, Vincent Y. F. Tan, and Yeow Meng Chee
   Submitted, IEEE Transactions on Information Theory, May 2023 (revised Sep 2023)
2. *Learning to Detect an Odd Restless Markov Arm with a Trembling Hand* arxiv
   P. N. Karthik and Rajesh Sundaresan
3. *Axiomatic Characterisation of Projection Rules: An Open Question* draft
   P. N. Karthik and Rajesh Sundaresan

Journal Publications

1. *Bus Priority lane in Bengaluru: A Study of its Effectiveness and Driver Stress*
   P. N. Karthik, Nihesh Rathod, Sarath Yasodharan, Wilson Lobo,
   Ajeesh Sahadevan, Rajesh Sundaresan and Pratik Verma
   Special Issue on Sustainable City Transportation in the Indian Subcontinent, Transport Policy, 2023.
   Doi: 10.1016/j.tranpol.2023.04.018
   Impact Factor: 6.173
2. *Best Arm Identification in Restless Markov Multi-Armed Bandits*
   P. N. Karthik, Kota Srinivas Reddy, and Vincent Y. F. Tan
   IEEE Transactions on Information Theory, volume 69, number 5, pp. 3240-3262, 2023.
   Doi: 10.1109/TIT.2022.3230939
   Impact Factor: 2.978
3. *Detecting an Odd Restless Markov Arm with a Trembling Hand*
   P. N. Karthik and Rajesh Sundaresan
   IEEE Transactions on Information Theory, volume 67, number 8, pp. 5230-5258, 2021.
   Doi: 10.1109/TIT.2021.3075021
   Impact Factor: 2.978

4. *Learning to Detect an Odd Markov Arm*
   P. N. Karthik and Rajesh Sundaresan
   IEEE Transactions on Information Theory, volume 66, number 7, pp. 4324-4348, 2020.
   DOI: 10.1109/TIT.2020.2972875
   IMPACT FACTOR: 2.978

DOCTORAL DISSERTATION

- *Sequential Controlled Sensing to Detect an Anomalous Process* pdf source etd iisc
  Ph.D. thesis, Department of ECE, Indian Institute of Science, NOV 2021

CONFERENCE PUBLICATIONS

1. *Best Arm Identification in Bandits with Limited Precision Sampling*
   Kota Srinivas Reddy, P. N. Karthik, Nikhil Karamchandani, and Jayakrishnan Nair
   IEEE International Symposium on Information Theory (ISIT 2023), JUN 2023
   DOI: 10.1109/ISIT54713.2023.10206610
2. *Almost Cost-Free Communication in Federated Best Arm Identification*
   Kota Srinivas Reddy, P. N. Karthik, and Vincent Y. F. Tan
   Proceedings of the 37th AAAI Conference on Artificial Intelligence (AAAI 2023), Washington D.C., FEB 2023.
   DOI: 10.1609/aaai.v37i7.26010
3. *Best Restless Markov Arm Identification*
   P. N. Karthik, Kota Srinivas Reddy, and Vincent Y. F. Tan
   Proceedings of the 2022 IEEE Information Theory Workshop (ITW 2022), IIT Mumbai, NOV 2022.
   DOI: 10.1109/ITW54588.2022.9965908
4. *Learning to Detect an Odd Restless Markov Arm*
   P. N. Karthik and Rajesh Sundaresan
   Proceedings of the 2021 IEEE International Symposium on Information Theory (ISIT 2021), virtual, JUL 2021.
   DOI: 10.1109/ISIT45174.2021.9518083
5. *Detecting an Odd Restless Markov Arm with a Trembling Hand*
   P. N. Karthik and Rajesh Sundaresan
   Proceedings of the 2020 IEEE International Symposium on Information Theory (ISIT 2020), virtual, JUN 2020.
   DOI: 10.1109/ISIT44484.2020.9174397
6. *Learning to Detect an Odd Markov Arm*
   P. N. Karthik and Rajesh Sundaresan
   Proceedings of the 2019 IEEE International Symposium on Information Theory (ISIT 2019), Paris, France, JUL 2019.
   DOI: 10.1109/ISIT.2019.8849807
7. *On The Equivalence of Projections in Relative α-Entropy and Rényi Divergence*
   P. N. Karthik and Rajesh Sundaresan
   Proceedings of the 34th National Conference on Communications (NCC 2018), IIT Hyderabad, FEB 2018.
   DOI: 10.1109/NCC.2018.8599980
8. *Model-Based Interference Cartography and Visualization*
   P. N. Karthik, Raksha Ramakrishna, Geethu Joseph, Chandra R. Murthy,
   Joyson Sebastian, and Neelesh B. Mehta
   Proceedings of the 22nd National Conference on Communications (NCC 2016), IIT Guwahati, MAR 2016.
   DOI: 10.1109/NCC.2016.7561174

PH.D. MENTORSHIP ASSISTANCE

CANDIDATE: Bharati Kamakoti (Ph.D., 3rd year)
SUPERVISOR: Prof. Krishna Jagannathan
INSTITUTE: IIT Madras
TOPIC: Transfer learning, best arm identification

CANDIDATE: Chen Zhirui (Ph.D., 2nd year)
SUPERVISOR: Prof. Vincent Y. F. Tan
INSTITUTE: National University of Singapore
TOPIC: Federated learning, best arm identification

Research Presentations

2023

1. *Almost Optimal Best Restless Markov Arm Identification with Fixed Confidence* slides video
   CNI Networks Seminar Series, Indian Institute of Science, Bengaluru, Aug 2023
2. *Almost Cost-Free Communication in Federated Best Arm Identification* poster
   Poster presentation, 37th AAAI Conference on Artificial Intelligence,
   Walter E. Washington Convention Center, Washington D.C., Feb 2023
3. *Almost Cost-Free Communication in Federated Best Arm Identification* slides video
   Invited talk, Workshop on Information Theory and Data Science,
   Institute for Mathematical Sciences, National University of Singapore, Jan 2023

2022

1. *Best Restless Markov Arm Identification* slides
   IEEE Information Theory Workshop, Mumbai, India, Nov 2022
2. *Behind the Scenes of $Ax = b$: Axioms and an Open Question* slides video
   A talk given to Prof. Vincent Tan's research group, Mar 2022

2021

1. *Sequential Controlled Sensing to Detect an Anomalous Process* slides video
   Ph.D. defence, Department of ECE, Indian Institute of Science, Nov 2021
2. *Finding a Markov Anomaly Quickly and Accurately* video certificate
   100 seconds competition organised by INAE Kanpur Chapter, Oct 2021
   First place under "Electronics and Communication Engineering" category
3. *GATE 2022: A Pathway to Research* video
   An online interactive session on the Graduate Aptitude Test in Engineering as a
   pathway to research organised by the Division of EECS, Indian Institute of Science, Oct 2021
4. *Information Geometry and its Applications to Statistics* video notes
   An online lecture for the students of Indian Institute of Science, Sep 2021
5. *Learning to Detect an Odd Restless Markov Arm* slides video
   IEEE International Symposium on Information Theory, Jul 2021
6. *Sequential Controlled Sensing to Detect an Anomalous Process* slides video
   Ph.D. colloquium talk, Department of ECE, Indian Institute of Science, Jun 2021
7. *Crack Open the GATE* video
   A session conducted for the students of R V College of Engineering, May 2021
8. *Probability in Real-Life: Example Applications from Visual Neuroscience,*
   Colour Blindness Detection, and Covid-19 Outbreak Modelling slides video
   A talk presented virtually to the 5th semester students and the faculty of the Department of
   Electronics and Communication Engineering, R V College of Engineering, Sep 2020

2020

1. *Odd Arm Identification in Multi-armed Bandits with Markov Observations* slides video certificate
   EECS Research Students' Symposium, Indian Institute of Science, Jul 2020
   Best paper award under "Signal Processing, Communication Networks, and Information Theory" track
2. *Detecting an Odd Restless Markov Arm with a Trembling Hand* slides video
   IEEE International Symposium on Information Theory, Jun 2020
3. *Visual Search with a Trembling Hand: An Analysis of Odd Arm Identification*
   in Restless Multi-armed Bandits slides video
   Centre for Networked Intelligence, Indian Institute of Science, May 2020
4. *On Detecting an Anomalous Arm in a Multi-armed Bandit with Markov Observations* slides
   STCS Symposium, Tata Institute of Fundamental Research, Mumbai, Jan 2020

2019

1. *Search in Research: The Importance of the Theory of Probability in Real-Life* slides
   R V College of Engineering, Dec 2019
2. *Learning to Detect an Odd Markov Arm* slides
   Lectures on Probability and Stochastic Processes XIV,
   Indian Statistical Institute Delhi, Dec 2019
3. *On Detecting an Anomalous Arm in Multi-armed Bandits with Markov Observations* slides
   Networks Seminar, Robert Bosch Centre for Cyber Physical Systems,
   Indian Institute of Science, Nov 2019
4. *Learning to Detect an Odd Markov Arm* poster
   Joint Telematics Group Summer School, Indian Institute of Technology, Madras, Aug 2019
5. *Learning to Detect an Odd Markov Arm* slides
   Program on Advances in Applied Probability,
   International Centre for Theoretical Sciences, Aug 2019
6. *Learning to Detect an Odd Markov Arm* slides
   IEEE International Symposium on Information Theory, Jul 2019
7. *A Short Course on Probability and Random Processes* course material
   R V College of Engineering, Jun 2019
8. $Ax = b$*: A Familiar Setup, Axioms and An Open Question* slides
   ECE Students' Seminar Series, Department of Electrical Communication Engineering,
   Indian Institute of Science, Feb 2019

2018 and Earlier

1. *On the Equivalence of Projections in Relative α-Entropy and Rényi Divergence* slides
   National Conference on Communications,
   Indian Institute of Technology, Hyderabad, Feb 2018
2. *On the Equivalence of Projections in Relative α-Entropy and Rényi Divergence* slides
   Lectures on Probability and Stochastic Processes XII,
   Indian Statistical Institute, Kolkata, Dec 2017

My Graduate Coursework

• Analysis – 1 (Real Analysis) • Analysis – 2 (Measure Theory) • Information Theory • Detection and Estimation Theory
• Random Processes • Error Correcting Codes • Calculus on Manifolds • Ordinary Differential Equations
• Online Prediction and Learning • Topics in Information Theory and Statistical Learning • Large Deviations
• Data Analytics • Concentration Inequalities

Professional Service

- Reviewer, IEEE Transactions on Information Theory
- Reviewer, IEEE Transactions on Signal Processing
- Reviewer, Journal on Selected Areas in Communications (JSAC)
- Reviewer, Conference on Neural Information Processing Systems (NeurIPS 2023)
- Reviewer, Conference on Decision and Control (CDC 2023)
- Reviewer, IEEE International Symposium on Information Theory (ISIT 2019, 2023)
- Reviewer, National Conference on Communications (NCC 2018)

Software Knowledge

Python | Microsoft PowerBI | Notion | LaTeX | MATLAB