

P. N. KARTHIK



PERSONAL DATA

DATE OF BIRTH: 20 APR 1992
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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 (BMTCC))
- 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 **GRADUATE TEACHING ASSISTANT**
AUG'18 - DEC'18 *Department of ECE, Indian Institute of Science, Bengaluru*
AUG'17 - DEC'17
- 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. *Optimal Best Arm Identification with Fixed Confidence in Restless Bandits* [arxiv](#)
[P. N. Karthik](#), Vincent Y. F. Tan, Arpan Mukherjee, and Ali Tajer
Submitted, Annals of Statistics, Oct 2023
2. *Fixed-Budget Differentially Private Best Arm Identification*
Chen Zhirui, [P. N. Karthik](#), Yeow Meng Chee, and Vincent Y. F. Tan
Submitted, SEP 2023
3. *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)
4. *Learning to Detect an Odd Restless Markov Arm with a Trembling Hand* [arxiv](#)
[P. N. Karthik](#) and Rajesh Sundaresan
5. *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](#)
RV 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](#)
RV 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

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](#) | [L^AT_EX](#) | MATLAB