# P. N. Karthik

## Research Interests

Multi-armed bandits, statistical learning, information theory, Markov decision processes, sequential analysis

## Experience

| | |
|---|---|
| Feb'24 - Present | **Assistant Professor** <br> *Department of Artificial Intelligence, IIT Hyderabad* <br> Date of joining: 26 February 2024 |
| Jan'22 - Jan'24 | **Research Fellow** <br> *Institute of Data Science, National University of Singapore* <br> Supervisor: Prof. Vincent Y. F. Tan |
| May'23 - Jun'23 | **Visiting Researcher** <br> *Technion Israel Institute of Technology, Haifa, Israel* <br> Host: Prof. Nir Weinberger |
| Nov'19 - Mar'20 | **Research Intern** <br> *Netradyne Technology India Pvt. Ltd., Bengaluru* <br> *In collaboration with Bengaluru Metropolitan Transport Corporation* <br> Academic Mentor: Prof. Rajesh Sundaresan <br> Industry Mentor: Pratik Verma |
| Aug'19 - Dec'19 <br> Aug'18 - Dec'18 <br> Aug'17 - Dec'17 | **Graduate Teaching Assistant** <br> *Department of ECE, Indian Institute of Science, Bengaluru* <br> Courses: Information Theory (E2 201), Random Processes (E2 202) <br> Instructors: Prof. Himanshu Tyagi, Prof. Utpal Mukherji, Prof. Parimal Parag |
| Aug'14 - Jun'15 | **Project Assistant** <br> *Department of ECE, Indian Institute of Science, Bengaluru* <br> Supervisor: Prof. Chandra R. Murthy |

## Education

| | |
|---|---|
| Jul'15 - Mar'22 | **Doctor of Philosophy and Master of Science (Engineering),** <br> Indian Institute of Science, Bengaluru <br> Department: Electrical Communication Engineering <br> Thesis: Sequential Controlled Sensing to Detect an Anomalous Process <br> Supervisor: Prof. Rajesh Sundaresan <br> GPA: 7.0/8.0 |
| Aug'10 - Jul'14 | **Bachelor of Engineering,** <br> R V College of Engineering, Bengaluru <br> Major: Electronics and Communications <br> GPA: 9.72/10.00 (RANK 2 among 140 students) |

## Publications

### Preprints

1. *Optimal Multi-Objective Best Arm Identification with Fixed Confidence*
   Chen Zhirui, P. N. Karthik, Yeow Meng Chee, and Vincent Y. F. Tan
   Submitted, Feb 2024

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. *Optimal Best Arm Identification with Fixed Confidence in Restless Bandits*  `arxiv`
   P. N. Karthik, Vincent Y. F. Tan, Arpan Mukherjee, and Ali Tajer
   Accepted, IEEE Transactions on Information Theory, 2024+

2. *Federated Best Arm Identification with Heterogeneous Clients*
   Chen Zhirui, P. N. Karthik, Vincent Y. F. Tan, and Yeow Meng Chee
   IEEE Transactions on Information Theory, volume 70, number 6, pp. 4258-4279, 2024
   **DOI:** 10.1109/TIT.2023.3338027

3. *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

4. *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

5. *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

6. *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

**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 with Arm Erasures*
   Kota Srinivas Reddy, P. N. Karthik, and Vincent Y. F. Tan
   IEEE International Symposium on Information Theory (ISIT 2024), Jul 2024

2. *Fixed-Budget Differentially Private Best Arm Identification*
   Chen Zhirui, P. N. Karthik, Yeow Meng Chee, and Vincent Y. F. Tan
   International Conference on Learning Representations (ICLR 2024), May 2024

3. *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

4. *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

5. *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

6. *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

7. *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

8. *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

9. *On The Equivalence of Projections in Relative $\alpha$-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

10. *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

## Research Presentations

**2024**

1. *A Peek into Reinforcement Learning* keynote
   A talk presented to the students and faculty of Andhra Mahila Sabha (AMS) as part of the workshop on
   Stepping into Modern AI (SMAI), Apr 2024

**2023**

1. *Optimal Best Arm Identification with Fixed Confidence in Restless Bandits* slides video
   National University of Singapore
   A talk presented to Prof. Vincent Tan's research group, Nov 2023

2. *Almost Optimal Best Restless Markov Arm Identification with Fixed Confidence* slides video
   CNI Networks Seminar Series, Indian Institute of Science, Bengaluru, Aug 2023

3. *Best Arm Identification with Limited Precision Sampling* slides
   National University of Singapore
   A talk presented to Prof. Vincent Tan's research group, Mar 2023

4. *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

5. *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
   National University of Singapore
   A talk presented 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

1. *On the Equivalence of Projections in Relative $\alpha$-Entropy and Rényi Divergence* [slides]
   National Conference on Communications,
   Indian Institute of Technology, Hyderabad, Feb 2018

2. *On the Equivalence of Projections in Relative $\alpha$-Entropy and Rényi Divergence* [slides]
   Lectures on Probability and Stochastic Processes XII,
   Indian Statistical Institute, Kolkata, Dec 2017

## 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

## Professional Service

- Reviewer, IEEE Transactions on Information Theory
- Reviewer, IEEE Transactions on Signal Processing
- Reviewer, Journal on Selected Areas in Communications (JSAC)
- Reviewer, International Conference on Machine Learning (ICML 2024)
- Reviewer, International Conference on Learning Representations (ICLR 2024)
- Reviewer, Conference on Neural Information Processing Systems (NeurIPS 2023, 2024)
- Reviewer, Conference on Decision and Control (CDC 2023)
- Reviewer, IEEE International Symposium on Information Theory (ISIT 2019, 2023, 2024)
- Reviewer, National Conference on Communications (NCC 2018)

## Software Knowledge

Python | Microsoft PowerBI | Notion | LaTeX | MATLAB