

# Kunal Pattanayak

## Education

- 2018–present **PhD, Electrical & Computer Engineering**, *Cornell University*, USA.  
Research Areas: Inverse Reinforcement Learning, Information Economics, Adversarial Machine Learning  
*Thesis Committee*: Vikram Krishnamurthy (chair), Jayadev Acharya, Siddhartha Banerjee
- 2017–2018 **Master of Technology**, *Indian Institute Technology, Kharagpur*, India.  
Masters in Telecommunication Systems Engineering.  
Research Area: Complex Systems Theory for calibrating Wireless Communication Protocols  
*Thesis Advisors*: Suvra Sekhar Das (IIT, Kharagpur), Nicola Marchetti (Trinity College, Dublin)
- 2013–2017 **Bachelor of Technology**, *Indian Institute Technology, Kharagpur*, India.  
Major: Electronics and Electrical Communication Engineering

## Publications (Google Scholar)

### Published Journal Articles

- 2021 Vikram Krishnamurthy, **Kunal Pattanayak**, Sandeep Gogineni, Bosung Kang, and Muralidhar Rangaswamy. Adversarial radar inference: Inverse tracking, identifying cognition, and designing smart interference. *IEEE Transactions on Aerospace and Electronic Systems*, volume 57, pages 2067–2081. IEEE, 2021.
- 2020 **Kunal Pattanayak** and Vikram Krishnamurthy. Necessary and sufficient conditions for inverse reinforcement learning of Bayesian stopping time problems. *arXiv preprint arXiv:2007.03481 (accepted with minor revision at Journal of Machine Learning Research)*, 2020.
- 2020 William Hoiles, Vikram Krishnamurthy, and **Kunal Pattanayak**. Rationally inattentive inverse reinforcement learning explains YouTube commenting behavior. *Journal of Machine Learning Research*, volume 21, pages 1–39. JMLR.org, 2020.

### Articles Under Review

- 2022 **Kunal Pattanayak**, Vikram Krishnamurthy, and Christopher Berry. How can a radar mask its cognition? (Submitted to *IEEE Transactions on Aerospace and Electronic Systems*). *arXiv preprint arXiv:2210.11444*, 2022.
- 2022 **Kunal Pattanayak**, Shashwat Jain, Vikram Krishnamurthy, and Christopher Berry. Adaptive ECCM for mitigating smart jammers (Submitted to *ICASSP*). *arXiv preprint arxiv:2212.02002*, 2022.
- 2021 **Kunal Pattanayak** and Vikram Krishnamurthy. Unifying Classical and Bayesian revealed preference (Submitted to *ACM Transactions Economics and Computation*). *arXiv preprint arXiv:2106.14486*, 2021.
- 2021 **Kunal Pattanayak** and Vikram Krishnamurthy. Rationally inattentive utility maximization for interpretable deep image classification (Submitted to *Artificial Intelligence (Elsevier)*). *arXiv preprint arXiv:2102.04594*, 2021.

### Book Chapters

- 2021 Vikram Krishnamurthy, **Kunal Pattanayak**, Sandeep Gogineni, Bosung Kang, and Muralidhar Rangaswamy. Adversarial radar inference: Inverse tracking, identifying cognition, and designing smart interference. *IEEE Transactions on Aerospace and Electronic Systems, Special section on meta-level and adversarial tracking*, 2021.

## Articles in Conference Proceedings

- 2022 **Kunal Pattanayak**, Vikram Krishnamurthy, and Christopher Berry. Meta-cognition. an inverse-inverse reinforcement learning approach for cognitive radars. In *2022 61st IEEE Conference on Decision and Control (CDC)*. IEEE, 2022.
- 2022 **Kunal Pattanayak**, Vikram Krishnamurthy, and Christopher Berry. Inverse-inverse reinforcement learning. how to hide strategy from an adversarial inverse reinforcement learner. In *2022 IEEE 25rd International Conference on Information Fusion (FUSION)*. IEEE, 2022.
- 2022 **Kunal Pattanayak**, Vikram Krishnamurthy, and Christopher Berry. How can a cognitive radar mask its cognition? In *ICASSP 2022-2022 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, pages 5897–5901. IEEE, 2022.
- 2020 **Kunal Pattanayak**, Vikram Krishnamurthy, and Erik Blasch. Inverse sequential hypothesis testing. In *2020 IEEE 23rd International Conference on Information Fusion (FUSION)*, pages 1–7. IEEE, 2020.
- 2018 **Kunal Pattanayak**, Aritra Chatterjee, Merim Dzaferagic, Suvra Sekhar Das, and Nicola Marchetti. A functional complexity framework for dynamic resource allocation in vanets. In *2018 14th International Wireless Communications & Mobile Computing Conference (IWCMC)*, pages 458–463. IEEE, 2018.

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## Research Projects and Internships

Cornell University, Ithaca, NY, USA

Aug, 2018 – present **Researcher at Cornell Statistical Signal Processing Laboratory.**

*Advisor:* Vikram Krishnamurthy

*Collaborators:*

*Industry:* Air Force Research Laboratory, Lockheed Martin

*Academia:*

Information Economics: Andrew Caplin (NYU) and Daniel Martin (UC, Santa Barbara).

Autonomous Driving/Imitation Learning: Sanjiban Choudhury (Cornell)

Theoretical contribution on the intersection of inverse reinforcement learning and information economics; illustrated performance of proposed algorithms on aerospace and online multimedia applications.

(i) Developed inverse reinforcement learning (IRL) algorithms for practical scenarios where the inverse learner has no access to the decision maker’s model dynamics. Analytically computed IRL performance guarantees for noisy and finite datasets (finite sample complexity results). Extended IRL methods to structured POMDPs like Bayesian stopping, controlled sensing and quickest detection. The proposed class of model dynamics-agnostic IRL algorithms provide a principled generative framework for black-box decision makers, hence are of significance to interpretable AI. Illustrated algorithm performance on predicting human-generated content on online multimedia platforms such as YouTube.

(ii) Developed counter-adversarial algorithms for masking decision strategy from an adversarial eavesdropper. Counter-adversarial algorithms are of significance to adversarial machine learning applications for designing secure systems robust to privacy leakage. Key ideas include formalizing trade-offs between compromising performance with adversarial mitigation due to deliberate sub-optimality in strategy.

(iii) Contribution to economics theory: Showed the equivalence of non-Bayesian and Bayesian methods in microeconomics and information economics for identifying strategy optimality in decision-making agents. Equivalence uses results from partial order theory for ordering probability distributions.

Trinity College, Dublin, Ireland

May-Aug, 2016 **Relating Complex Systems Theory to Wireless Communication Networks.**

*Principal Investigators:* Nicola Marchetti, Suvra Sekhar Das

(i) Proposed a complex systems theory based predictive controller for parameter-tuning of decentralized wireless communication protocols.

(ii) Illustrated the model predictive control algorithm on a MATLAB-based simulator for the Self-organized Time Division Multiple Access (SOTDMA) protocol. SOTDMA is widely used in ships and other maritime applications for real-time localization.

## RADAR, New York, NY, USA

May-Aug, **RFID-based Inventory Tracking for Retail Stores.**

2022 *Mentors:* Prokopios Panagiatou and Debarun Dhar

- (i) Analyzed RADAR's inventory tracking algorithm; collaborated with the engineering and product team to identify key enhancement features.
- (ii) Generated a simulation-based look-up table that maps business KPIs to micro-level logistic and engineering specifications. This look-up table yields the approximate engineering specs required for achieving a high-level business KPI, for example, aggregate inventory accuracy.
- (ii) Prototyped a discrete event simulator for testing inventory algorithm variants before real-time deployment. The simulator emulates real-time customer behavior in a retail store, where behavior events include customer movement, item browsing, trying out apparel and item check-out.

## Qualcomm Inc., Hyderabad, Telangana, India

May-Aug, **Downlink Carrier Signal Processing for Qualcomm's QDSP6 Processor.**

2017 *Mentor:* PB Srinivas

- (i) Unified the downlink signal processing software threads for ease of access and increased transparency.
- (ii) Proposed and developed an adaptive multi-threading scheduler for downlink carrier signal processing that decreased the latency variance by 20%.

## Gunpoint Technologies LLP, Kharagpur, India

Jan, 2015 - **Designing Communication Protocols on Embedded Systems for Battlefield Simulation (a.k.a LaserTag).**

March, 2016 *Mentors:* Arpan Bose, Nagendra Babu, Priti Pallavi

- (i) One of the first members of the company while being a full-time student. Developed communication protocols on ARM microprocessors using ZigBee (radio) and Infrared transponders for real-time communication in battlefield simulation systems.
- (ii) Actively involved in marketing, publicity, and organizing campus demonstrations.
- (iii) Pivotal contributor in company's product release of India's first (and world's third) commercial battlefield simulation system technology (patent pending).

## Academic Achievements, Awards & Recognitions

- 2020 Invited Speaker at the *2020 Sloan-Nomis Conference on Attention and Applied Economics* for published work in *Journal of Machine Learning Research (JMLR)* on understanding YouTube commenting behavior using information economics tools
- 2018 Awarded the prestigious *McMullen Scholarship* for meritorious incoming PhD students
- 2013 Secured 99 percentile in *NSEP* (National Standard Examination in Physics), the precursor to Indian Physics Olympiad (InPhO)
- 2012 Awarded the coveted *KVPY Fellowship* by Govt. of India for pursuing pure sciences

## Professional Activities

- Reviewer IEEE Transactions on Forensics and Information Security, IEEE Transactions on Signal Processing, IEEE Transactions on Control Systems, AISTATS, CDC, ICASSP, FUSION
- Organizer Actively involved in organizing the FIND seminar, a bi-weekly seminar hosted by ECE that features esteemed researchers from both academia and industry.

## Skills and Technical Experience

- Languages Python, MATLAB, C, C++, C#, Verilog
- Libraries/Tools PyTorch, Tensorflow, Keras, Pandas, Sklearn, SQL, Amazon Web Services, Google Cloud

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## Graduate Coursework

**Signal Processing:** Bayesian Estimation and Stochastic Estimation, Applied Stochastic Processes

**Machine Learning:** Advanced Machine Learning, Statistical Learning Theory

**Mathematics:** Measure Theoretic Probability, Financial Engineering with Stochastic Calculus

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## Teaching Assistanship

2023 **ECE 2720. Data Science for Engineers**, *Cornell University*.

Teaching Assistant for Aaron Wagner

2022, 2021 **ECE 2720. Data Science for Engineers**, *Cornell University*.

Teaching Assistant for Vikram Krishnamurthy

2020 **ECE 3250. Signals and Systems**, *Cornell University*.

Teaching Assistant for Adam Bojanczyk

2018 **Digital Communication**, *Indian Institute of Technology, Kharagpur*.

Laboratory Assistant for Ritwik Layek

2017 **Analog Communication**, *Indian Institute of Technology, Kharagpur*.

Laboratory Assistant for Saswat Chakrabarti

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## Mentoring

**Undergrad students** Aman Gupta (Apple), Shashank Verma (Qualcomm), Vivek Rangamgari (Qualcomm Research), Abhinav Verma (Qualcomm Research), Shailesh Mishra (PhD, EPFL)

**Graduate students** Zeren Zhang (M.Eng, Cornell), Shashwat Jain (PhD, Cornell), Adit Jain (PhD, Cornell)

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## Extracurricular Activities

**Culture Immersion** Currently serve as President of Proyecto Pa'lante, a graduate student group at Cornell university dedicated to community-building through the promotion of Latin dance. Actively involved in conducting workshops on Latin dance forms on campus.

**Community Outreach** Served as Hostel Representative for the Institute Wellness Group, Indian Institute of Technology, Kharagpur, to uplift, nurture and spread awareness on mental health of college students.

**Sports** Currently part of Cornell university's club squash team.  
Represented Indian Institute of Technology, Kharagpur in Lawn Tennis at the 2016 and 2017 Inter-IIT Sports meet.