JAPNEET SINGH

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EDUCATION

Masters of Technology (M.Tech.) and Bachelor of Technology (B.Tech.)	UG: 9.6/10
Both in Electrical Engineering (Dual Degree Program).	PG: 10/10
- Indian Institute of Technology, Kanpur	*2017 - 2022 (Expected)*

RESEARCH INTERESTS

Information and Coding Theory, Convex Optimization, Wireless Communications, Machine Learning

PUBLICATIONS

Universal Weighted Matrix Completion- An application to Topological Interference Management
Japneet Singh, Zeeshan Akhtar, Adrish Banerjee, Ketan Rajawat; in preparation   [Preprint]

Secure and Private Fountain Code Based Architecture for Blockchains
Japneet Singh, Adrish Banerjee, Hamid Sadjadpour; accepted at WCNC-2022   [Link]

Conditional generative models for sampling and phase transition indication in spin systems
Japneet Singh, Mathias S. Scheurer, Vipul Arora - *SciPost Physics, 2021*   [Link]

SCHOLASTIC ACHIVEMENTS

2021	Winner of **Qualcomm Innovation Fellowship India, 2021**	*India*
2021	Selected for **International Summer Research Program, 2021**	UC Santa Cruz
2020	Selected for **Mitacs Globalink Research Internship 2020** and **DAAD-WISE Scholarship 2020** ‡	-
2019	**Summer Undergraduate Research Grant for Excellence (SURGE)**	*IIT-Kanpur*
2017-21	**Academic Excellence Award**, for 4 consecutive academic years.	*IIT-Kanpur*
2017	**All India Rank 644**, JEE Advanced 2017, out of 160,000 candidates	*India*
2017	**All India Rank 776**, JEE Mains 2017, out of 1.2 million candidates	*India*
2016	**KVPY scholarship Awardee,** All India Rank 280	*India*

‡ : *Offer was later rescinded due to Covid-19 Outbreak*

RESEARCH EXPERIENCE LEADING TO PUBLICATION

Online Matrix Completion Algorithms for Topological Interference Management
M.Tech Thesis, Advisor: Prof. Adrish Banerjee and Prof. Ketan Rajawat, IIT Kanpur Aug 2021 -

- Developed the first known result on the unique recovery of the underlying matrix for Universal Weighted Matrix Completion where the revealed entries may not be oblivious to underlying matrix.
- Obtained results foreground the effect of the quality of prior subspace information on the number of entries needed for unique recovery of the underlying Matrix.
- Used the above results for solving a structured matrix completion problem arising in Topological Interference Management which previously could not be solved by Nuclear Norm Minimization.
- Developed a scalable algorithm for solving the Weighted Nuclear Norm Minimization problem using Augmented Lagrangian and provided its convergence analysis.

Secure and Private Fountain Code Architecture for Blockchains   *May 2021 - July 2021*
International Summer Research Program under Prof. Hamid Sadjadpour, UC Santa Cruz

- Introduced two new architectures which reduce the storage and communication costs associated with blockchain's historical data and simultaneously provides the confidentiality of the stored data.
- The two protocols are designed using a combination of fountain codes and a proposed communication and repair efficient secret sharing scheme.
- Developed a construction of the Secret Sharing Scheme satisfying the requirements of the protocol.

Conditional Generative model for sampling and phase transition indication in spin systems
SURGE Program under Prof. Vipul Arora, IIT-Kanpur *May 2019 - Dec 2020*

- Explored the use of conditional Generative models to generate lattices for a given temperature for XY lattice model to mitigate the critical slowing down of MCMC algorithms near phase transition.
- Used trained Generative Adversarial Networks models for un-supervised phase transition detection.
- Proposed a Energy conditioned GAN model, which integrates with MCMC and breaks the markov chain by doing an over-relaxation step, and also adapts to the errors in the learned distribution.
- Obtained much better modelling accuracy over previous approaches and reduced correlation among samples generated by the trained model.

COURSE PROJECTS AND COMPETITIONS

Configuring Intelligent Reflecting Surfaces (IRS) for Wireless Communications - [Report]
IEEE Signal Processing Cup 2021 under Prof. Abhishek Gupta *Jan 2021- Apr 2021*

- Improvised Projected Gradient Ascent and Newton's Algorithm for optimizing the IRS configuration for maximizing the Spectral Efficiency of the system.
- Estimated Channel model using Least Squares and generalized a Dictionary Learning based scheme to the IRS system model for frequency selective channels.
- Achieved 14th place out of 50 competing international teams.

Content Caching in Matern Cluster Process - [Report, Slides] *Jan 2021- Apr 2021*
Course project for EE698O - 'Analysis of Modern Wireless Networks' under Prof. Abhishek Gupta

- Derived the expressions for Cache Aided Throughput in Matern Clustered Process (MCPs), using the framework of stochastic geometry, when both the Base Stations (BS) and users cache the files.
- The analysis was done separately for both In-Band and Out-band Device to Device communication.

Newton's Sketch for Non-separable functions - [Report, Slides] *Oct 2020 - Dec 2020*
Course project for EE698U - 'Optimization for Big Data' under Prof. Ketan Rajawat *IIT-Kanpur*

- Analyzed feasibility and un-biasedness of a new sketching technique for Newton's method which does not require computing square-root of the Hessian matrix.
- Showed Local Linear-Quadratic convergence of Newton's method under this sketching scheme.
- Developed a global convergence analysis of sketched Newton for self-concordant functions.

On the Capacity of Computation Broadcast - [Slides] *Sept. 2020 - Nov. 2020*
Course Project for EE667 - 'Information Theory' under Prof. R. K. Bansal, *IIT-Kanpur*

- Read about the problem of Computation Broadcast and its relation to Index Coding and some special cases of Computation Broadcast problem.
- Gave a talk on the same, explaining how generalizing the Index Coding problem yields interesting insights about its capacity region of Index coding problem under some special cases.

Fundamentals of Index Coding - [Slides] *Sept. 2020 - Nov. 2020*
Course project for EE668U - 'Coding theory' under Prof. Adrish Banerjee *IIT-Kanpur*

- Read a survey paper on 'Fundamentals of Index Coding' and explored related papers.
- Gave a talk on the same, explaining the duality between Index Coding problem and Locally Recoverable Distributed Storage Problem.

BAJA SAE, IIT-K Motorsports - [Report] *Mar. 2018 - Mar. 2019*
Member, Faculty Advisor: Prof. Santanu De, *IIT-Kanpur*

- Implemented and designed multi-link suspension for an All-Terrain vehicle.
- Used MATLAB for development of suspension kinematics using numerical optimization techniques.
- Used MATLAB for obtaining the graphs depicting the variation of various suspension parameters with travel, steer of wheel and created a program for finding suspension forces.
- Finished 13th among 80 teams all over India and 12th in endurance event at Mega ATV-2019.

SKILLS

Programming	Python, C/C++
Libraries	NumPy, TensorFlow, Keras
Software Skills	MATLAB, Simulink, Git, LaTeX, SolidWorks, Altium

RELEVANT COURSEWORK

- Analysis of Modern Wireless Networks
- Information Theory
- Convex Optimization
- Wireless Communication
- Probability and Statistics
- Principles of Communication
- Machine Learning for Signal Processing
- Topics in Stochastic Processes
- Coding Theory
- Optimization for Big Data
- MIMO Wireless Communication
- Applied Stochastic Processes
- Digital Communications
- Detection and Estimation Theory

MISCELLANEOUS

- Served as a TA for MOOC Information Theory Course NOC21-EE57 (Spring 2021) organized by NPTEL. Created Assignments, uploaded lectures and ensured smooth running of the course.

- Served as Volunteer for ICML 2020, NeurIPS 2020, ICML 2021, NeurIPS 2021, JTG Summer school 2021, NCC 2021. Helped in arranging Zoom meetings, detecting platform bugs and interacting with authors to break the ice during online poster sessions and talks.