Sourbh Bhadane

CONTACT
INFORMATION

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RESEARCH
INTERESTS

Information theory, Coding theory, Distributed Storage, Wireless Networks, Statistical Learning

EDUCATION

Indian Institute of Technology Madras

B.Tech. and M.Tech in Electrical Engineering; **CGPA: 8.48/10** (after 9 semesters) 2012 – present

Abasaheb Garware College, Pune, India

Higher Secondary Certificate Examination (HSC)   2012
- Scored **79.8%** in HSC

D.A.V Public School, Pune, India

All India Secondary School Examination (AISSE)   2010
- Scored **95.8%** in AISSE

SELECTED
PUBLICATIONS /
POSTERS

- **Sourbh Bhadane**, Andrew Thangaraj, "Unequal Locality and Recovery for Locally Recoverable Codes with Availability", *Twenty third National Conference on Communications (NCC), 2017* (accepted)

- Akshay K Gulati, **Sourbh Bhadane**, Joseph Samuel, Harishankar Ramachandran, R David Koilpillai, "IITMSAT[1]: Innovative Packet Protocol and Concept of Operations", *AIAA/USU Conference on Small Satellites, 2016* poster

- Jagdish Mevada, Joseph Samuel, **Sourbh Bhadane**, Akshay K Gulati, R.D. Koilpillai, "Design and Implementation of a Robust Downlink Communication System for Nanosatellites", *IEEE International Conference on Space Science and Communications (IconSpace) 2015* pp. 164-169.

RESEARCH
EXPERIENCE

Locally Recoverable Codes (LRCs) with Multiple Recovering Sets   (June 2016-Present)

Master's Thesis project, IIT Madras, Chennai, India

Guide : Prof. Andrew Thangaraj *(IIT Madras)*

- Generalized an existing construction to show optimality in terms of distance for LRCs with all-symbol locality and availability.
- Obtained new upper bounds on minimum distance for codes with unequal locality and availability
- Proposed an explicit optimal parity-check matrix construction for LRCs with information locality and availability that improves upon existing constructions in terms of field size
- Proved looseness of a rate upper bound for LRCs with multiple recovering sets for linear codes

Sum-rate upper bounds for MIMO Z Channels and weighted sum-rate maximization for Gaussian MIMO MAC   (Oct 2015 - Mar 2016)

Guide : Prof. Srikrishna Bhashyam *(IIT Madras)*

- Showed equivalence of proving tightness of a recently proposed upper bound wrt an existing upper bound for sum-rate of MIMO Z Channels to a comparison of relevant determinants using convex analysis
- Worked on finding a waterfilling-like algorithm to obtain optimal covariance matrices to maximize weighted sum-rate for MIMO Multiple Access Channels

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[1]IITMSAT is the nanosatellite initiative of IIT Madras

Robust Downlink Communication System for IITMSAT (Dec 2013 - Jul 2015)
Guide : Prof. David Koilpillai (IIT Madras)

- Developed novel customized data-link layer communication protocols for communication between Ground Station at IIT Madras
- Initiated Concept of Operations for the satellite which required thorough system-level understanding of the entire satellite
- Implemented a GNURadio interface between the Ground Station Software and Persues Software Defined Radio (SDR)
- Implemented a hard-decision Viterbi decoder for a rate half convolutional code in GNURadio for a customized SDR based receiver

SCHOLASTIC ACHIEVEMENTS

- Awarded the **Indian National Mathematical Olympiad (INMO) Merit Certificate** for consecutive years (awarded to the **top 75** students among INMO candidates across India), by Homi Bhabha Centre for Science Education, TIFR 2011, 2012
- Recipient of **Kishore Vaigyanik Protsahan Yojana (KVPY)** fellowship, awarded by Department of Science and Technology, (DST), Government of India 2012
- Secured **All India Rank** of **744** among 485,000 students in IIT-JEE 2012. 2012
- Placed among the **top 1%** in India in **NSEP** (National Standard Examination in Physics) and **top 1%** in the state of Maharashtra in **NSEA** (National Standard Examination in Astronomy) conducted by the Indian Association of Physics Teachers (IAPT) 2011

SELECTED COURSE PROJECTS

Capacity Upper Bounds for Diamond Channels (Jul-Nov 2016)
Topics in Random Processes and Concentrations (EE6112)   *Instructor : Prof. Krishna Jagannathan*

- Studied Wu-Özgür-Xie's paper on improving cut-set bound for primitive relay channels using measure concentration inequalities
- Derived tighter upper bounds to the capacity of the symmetric diamond relay channel using the above approach [term paper]

Poisson Point Process vs Hexagonal Grid Models for Downlink Cellular Networks (Apr-May 2016)
Wireless and Cellular Communications (EE5141)   *Instructor : Prof. K. Giridhar*

- Compared both models via Monte Carlo simulations using coverage probability as a performance measure.
- Implemented a Bayesian-like method to increase coverage probability performance for the Poisson Point Process model under frequency reuse one-third. Performed simulations to verify the increase in performance. [presentation]

Design, Construction and Simulation of LDPC and Turbo Codes (Oct-Dec 2015)
Modern Coding Theory (EE5161)   *Instructor : Prof. Pradeep Sarvepalli*

- Designed degree distributions using EXIT Charts and implemented discretized density evolution for a rate half LDPC code over a BiAWGN channel.
- Implemented Mckay's random constructions for $n = 1000, 2000, 4000$ and implemented a log-likelihood version of the sum-product algorithm (SPA) decoder [LDPCreport],
- Simulated the performance of a PCCC log BCJR decoder for the UMTS Turbo Code on the BiAWGN channel. [Turbo code report]

Huffman Encoding and Shannon Capacity (Apr-May 2015)
Information Theory (EE5162)   *Instructor : Prof. Pradeep Sarvepalli*

- Implemented a Huffman encoding and decoding algorithm in Python.
- Characterized geometrically all binary input, binary output DMCs of a fixed capacity [report]

RELEVANT COURSES	• **Core Engineering :** Networks and Systems, Analog & Digital Signal Processing, Adaptive Signal Processing • **Communications :** Error Control Coding, Modern Coding Theory, Information theory, Communication Systems, Wireless Communications, Detection and Estimation Theory, Advanced topics in Communications (Network Information Theory) $^{\alpha}$ [2], Advanced Topics in Communication (Information Theory and Inference)$^{\beta}$ • **Mathematics :** Calculus I Functions of One Variable,Calculus II Functions of Several Variables, Optimization Methods in Signal Processing and Communications (Convex Optimization), Probability foundations for Electrical Engineers, Graph Theory, Topics in Random Processes and Concentrations$^{\alpha}$ (Martingales and Concentration Inequalities) • **Other relevant courses :** Machine Learning, Reinforcement Learning, Control Systems, Computational Neuroscience, Quantum Physics, Statistical Physics, Pseudorandomness$^{\beta}$ (Modern Techniques in Theory of Computation)
TECHNICAL SKILLS	• **Programming Languages** - C, C++, Python • **Other Tools** - MATLAB, GNURadio, STK Toolkit, AutoCAD, Django, LaTeX • **Operating Systems** - Windows, Linux (Ubuntu)

POSITIONS OF
RESPONSIBILITY
	• **Web Operations Coordinator - Backend Web Developer**, Shaastra[3] 2013-14
	  – Developed an Enterprise Resource Portal (ERP) in Django for the use of the entire organizing team of Shaastra
	  – Developed a hospitality portal in Django for accomodation of over 50000 students over 3 days of Shaastra
	
	• **IITMSAT Ground Station Software Lead**, IIT Madras 2014-15
	  – Designed a problem statement for selection of candidates for the IITMSAT Ground Station Software team
	  – Led the selected team to build a fully functional Ground Station Software
	
	• **Teaching Assistant**, IIT Madras 2016
	  – Teaching assistant for the graduate course, Information Theory and Coding
	  – Corrected examination papers, helped students with their assignments and catered to their doubts

EXTRA-
CURRICULAR
	• **Hockey**
	  – Goalkeeper of IIT Madras Hockey team that won **Bronze medal** at the inter-college Dhyanchand tournament, YMCA Chennai 2016
	  – Goalkeeper of IIT Madras Hockey team that won **Bronze medal** at the inter-college Sport-Fest conducted by IIT Madras 2016
	  – Member of the Saraswathi Hostel Hockey Team that won **Gold**, **Bronze**, **Gold** medals in Schroeter - IIT Madras Inter Hostel sports meet 2014,2015,2016
	
	• **Technical**
	  – Set up a test system in IIT Madras to assess quality of VoIP calls over WiFi under overload for ultimately setting up a WiFi based communication system for the police at Mahamaham [4]
	  – Participated in Hackfest, Shaastra 2013

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[2]α represents ongoing courses, β represents courses to be done next semester
[3]Shaastra is IIT Madras' annual technical festival
[4]Mahamaham is a festival attended by over 10 lakh people at Mahamaham Tank (6.2 acres)