

# Siddharth Jain

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CONTACT INFORMATION	Department of Electrical Engineering (EE) Caltech Paradise Lab, Moore 311, MC 136-93, Caltech Pasadena, CA, 91125, USA	<i>Cell:</i> +1 626-652-1958 <i>E-mail:</i> <a href="mailto:sidjain@caltech.edu">sidjain@caltech.edu</a> <i>Web:</i> <a href="http://paradise.caltech.edu/~sidjain">paradise.caltech.edu/~sidjain</a>
RESEARCH INTERESTS	Information and Coding Theory, Pattern Recognition, Data Compression, Machine Learning, Bioinformatics.	
EDUCATION	<b>California Institute of Technology</b> <i>Graduate Student, Electrical Engineering ; GPA 4.1/4</i>	Advisor: Prof. Jehoshua Bruck <i>Sept. 2013 - present</i>
	<b>Indian Institute of Technology Kanpur</b> <i>B. Tech and M. Tech in Electrical Engineering</i> <i>GPA: B. Tech 9.9/10, M. Tech 10/10</i> <b>Erdős Number: 2.</b>	Advisor: Prof. R. K. Bansal <i>2008 - 2013</i>
SELECTED RESEARCH TOPICS	<b>Codes for DNA Storage</b> (with Jehoshua Bruck, Moshe Schwartz and Farzad Farnoud) Design codes for DNA storage under duplication and substitution errors.	
	<b>String Duplication Systems</b> (with Jehoshua Bruck, Noga Alon and Farzad Farnoud) Motivated by the phenomenon of tandem duplications observed in DNA, we investigate <ul style="list-style-type: none"><li>• The diversity of sequences that can be generated by a series of tandem duplications applied on a seed. This diversity is characterized by mathematical measures of capacity and expressiveness.</li><li>• Given a sequence, we calculate upper and lower bounds on the number of steps required to reduce the sequence by omitting tandem repeats to its seed. We also develop algorithms that perform near optimal reduction.</li></ul>	
	<b>Nested Tandem Repeat Finder</b> (with Jehoshua Bruck and Farzad Farnoud) A software developed by us to find nested tandem repeat in a sequence. We use it to compare the distribution of nested tandem repeats in coding and non-coding region in DNA of different species.	
	<b>Match Lengths, Zero Entropy and Large Deviations</b> (with R. K. Bansal) We investigate the match length expression in the context of Sliding Window Lempel-Ziv Algorithm for zero entropy sequences. We also prove large deviation property for recurrence times and propose entropy estimator based on them under certain mixing conditions.	
	<b>Fractional Calculus based approaches in Control</b> (with Paul Bogdan and Radu Marculescu) We propose a fractal optimal controller for heart rate control through pacemaker. The dynamics of the the heart rate are modeled by fractional differential equation. We also use a similar approach to perform power management for multi-voltage and frequency islands multiprocesser platforms.	
PUBLICATIONS	<b>Journal</b>	
	1. <b>Siddharth Jain</b> , Farzad Farnoud, Moshe Schwartz, Jehoshua Bruck <i>Noise and Uncertainty in String-Duplication Systems</i> to be submitted to IEEE Transactions on Information Theory.	
	2. <b>Siddharth Jain</b> , Farzad Farnoud, Moshe Schwartz, Jehoshua Bruck <i>Duplication Correcting Codes for Data Storage in the DNA of a living organism</i> submitted to IEEE Transactions on Information Theory.	

3. Noga Alon, Jehoshua Bruck, Farzad Farnoud, **Siddharth Jain**  
*Duplication Distance to the root for binary sequences.*  
submitted to IEEE Transactions on Information Theory.
4. **Siddharth Jain**, Farzad Farnoud, Jehoshua Bruck  
*Capacity and Expressiveness of Genomic Tandem Duplication.*  
submitted to IEEE Transactions on Information Theory.
5. **Siddharth Jain**, R. K. Bansal  
*On Match Lengths, Zero Entropy and Large Deviations - with Application to Sliding Window Lempel-Ziv Algorithm.*  
IEEE Transactions on Information Theory, vol. 61, no. 1, pp. 120-132, January 2015.
6. Paul Bogdan, **Siddharth Jain**, Radu Marculescu  
*Pacemaker Control of Heart Rate Variability: A CPS Perspective.*  
ACM Transactions on Embedded and Computing Systems (TECS), vol. 12, no. 1s, article 50, March 2013.
7. Paul Bogdan, Radu Marculescu, **Siddharth Jain**  
*Dynamic Power Management for Multi-domain Processor Systems-on-Chip Platforms: An Optimal Control Approach.*  
ACM Transactions on Design Automation of Electronic Systems (TODAES), vol. 18, no. 4, article 46, October 2013.

#### Conference

1. **Siddharth Jain**, F. Farnoud, M. Schwartz, J. Bruck  
*Noise and Uncertainty in String-Duplication Systems*  
submitted to IEEE International Symposium on Information Theory (ISIT), 2017.
2. **Siddharth Jain**, F. Farnoud, M. Schwartz, J. Bruck  
*Duplication Correcting Codes for DNA Storage in DNA of living organism*  
in Proceedings of IEEE International Symposium on Information Theory (ISIT), pp. 1028-1032, July 2016.
3. Noga Alon, J. Bruck, F. Farnoud, **Siddharth Jain**  
*Duplication Distance to the root for Binary Sequences*  
in Proceedings of IEEE International Symposium on Information Theory (ISIT), pp. 260-264, July 2016.
4. **Siddharth Jain**, F. Farnoud, J. Bruck  
*Capacity and Expressiveness of Genomic Tandem Duplication.*  
in Proceedings of 2015 IEEE International Symposium on Information Theory (ISIT), pp. 1946-1950, July 2015.
5. **Siddharth Jain**, R. K. Bansal  
*On Match Lengths and Asymptotic Behavior of Sliding Window Lempel-Ziv Algorithm for Zero Entropy Sequences.*  
IEEE International Symposium on Information Theory (ISIT), pp. 2885-2889, Jul 2013.
6. **Siddharth Jain**, R. K. Bansal  
*On Large Deviation Property of Recurrence Times.*  
IEEE International Symposium on Information Theory (ISIT), pp. 2880-2884, Jul 2013.
7. Paul Bogdan, Radu Marculescu, **Siddharth Jain**, Rafael Tornero  
*Optimal Power Management of Multidomain Multiprocessor Platforms under Highly Variable Workloads.*  
Proceedings of the 6th ACM/IEEE International Symposium on Networks-on-Chip (NOCS), pp. 35-42, May 2012 (**Best Paper Award**)
8. Paul Bogdan, **Siddharth Jain**, Kartikeya Goyal, Radu Marculescu  
*Implantable Pacemakers Control and Optimization via Fractional Calculus Approaches: A*

*Cyber-Physical Systems Perspective.*

Proceedings of the ACM/IEEE 3rd International Conference on Cyber-Physical Systems (IC-CPS), pp. 23-32, April 2012.

### Invited Talks

1. *Decoding the Past.*  
Molecular Programming Project (MPP) Workshop, Boston, Massachusetts, December 2016.
2. *Biological Information Channel.*  
IPAM Computational Genomics Summer Institute (CGSI), UCLA, July 2016.
3. *Duplication Correcting Codes for DNA Storage.*  
Molecular Programming Project (MPP) Workshop, Seattle, Washington, January 2016.

### Posters

1. **Siddharth Jain**, F. Farnoud, M. Schwartz, Jehoshua Bruck  
*Capacity and Diversity of Tandem Duplication.*  
Molecular Programming Project (MPP) Workshop, Jan 9-11, 2015, San Francisco California.  
*[Invited]*

### ACADEMIC ACHIEVEMENTS

- PhD fellowships from Caltech, Cornell, USC, UCSD, CMU.
- **Best paper award** at 6th ACM/IEEE International Symposium on Networks-on-Chip (NOCS), 2012
- Ranked **first** out of 97 EE UG and dual degree students and **first** out of 221 five year course students at IIT Kanpur.
- **Academic Excellence Award** (awarded to top 5%) for all academic years at IIT Kanpur
- Selected for **CSSI REU-Internship at Carnegie Mellon University** given to 5 students all over India, 2011
- Selected among top 2 undergraduate students of IIT Kanpur for **Indo German Winter Academy, 2010** to attend a course on Semiconductor Processes and Devices
- Ranked Amongst top 0.2% students in India writing the **Indian Institute of Technology Joint Entrance Exam (JEE)** 2008
- **Certificate of merit** in Chemistry (awarded to top 0.1% in the country) in All India Senior Secondary Certificate Examination 2008

RELEVANT COURSES Combinatorics, Communication Theory (A), Statistical Inference, Information Theory (A,B), Learning Systems, Error Correcting Codes, Theory of Computation, Data Structures and Algorithms, Randomized Algorithms, Signals, Systems and Networks, Digital Signal Processing, Image Processing, Wavelet Transforms for Signal and Image Processing, Probability (A,B), Stochastic Processes, Markov Chains, Real and Complex Analysis, Differential Equations, Control System Analysis, Linear Estimation.

COMPUTER SKILLS **Languages:** C, C++,  $\text{\LaTeX}$ , HTML

**Softwares:** Matlab, Microcap

**Tools Used:** Convex Optimization, Time Series Analysis, Signal Processing Tool in Matlab

POSITION OF  
RESPONSIBILITY

Treasurer of the Caltech Cricket Club (Sept 2015 - present)

Head TA for IST4 (Spring 2015, 2016)

- An Information and Logic class offered to undergraduates at Caltech

Treasurer of the Indian Subcontinent Organization at Caltech (Sept 2014-Aug 2015)

TA- Representation and Analysis of Random Signals at IIT Kanpur (Aug 2012-Nov 2012)

Link Student, Counselling Service, IIT Kanpur

Mentor at National Service Scheme (NSS), India