

Shayan Srinivasa Garani

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Research Interests

Broad area of mathematical systems science and complex systems engineering, applications of signal processing, information theory and coding towards physical nano memories, emerging areas in quantum information processing, VLSI system architectures.

Education

Georgia Institute of Technology, Atlanta, GA **2002-2006**

Ph.D in electrical and computer engineering. Minor in mathematics.

Graduation date: July 2006

Dissertation Advisor : Prof. Steven W. McLaughlin

Dissertation Topic : Constrained coding and signal processing for holography.

University of Florida, Gainesville, FL **Aug 1999 - May 2001**

M.S in electrical and computer engineering.

Thesis Advisor : Prof. Jose C. Principe

Thesis Topic : An activity diffusion enhancement to vector quantizers.

University of Mysore, (S.J.C.E., Mysore) India **Aug 1993 - Aug 1997**

B.E in electronics and communication engineering, University rank holder.

Project Thesis Advisor : Drs. Ashok Rao and B. S. Adiga

Project Thesis Topic : Speech and image compression through wavelets.

Employment History

Indian Institute of Science, Bangalore, India **Fall 2012 - present**

Title : Assistant Professor, Department of Electronic Systems Engineering

Director : Physical Nano-memories, Signal and Information Processing Systems Laboratory

Western Digital, Irvine, U.S.A **Fall 2012 - 2013**

Title : Technology Consultant

Western Digital Technologies, Irvine, California, U.S.A **2010 - 2012**

Title : Sr. Principal Staff Engineer/Sr. Engineering Manager: Advanced Channels, Chairman ASTC Signal Processing

Group : Advanced Technology Division under the office of the CTO.

Profile/Work Duties :

- Invent novel channel coding and signal processing schemes for recording systems, perform theoretical analysis for predicting the reliability of media recording channels and systems.
- Lead new initiatives for technological research and development towards high capacity and reliable storage systems. Establish a road map for future research activities.
- Interfacing with various engineering divisions to realize in-house R&D .
- Directing and managing funded research collaborations with universities.

- Chairman for IDEMA-ASTC signal processing. Developed signal processing roadmap for storage technology, solicited and reviewed university proposals along with other committee members. Established a framework for managing ASTC collaborations.
- Knowledge creation and dissemination through seminars, invited talks, publications and patents.

STMicroelectronics Inc., San Diego, California, U.S.A

2006 - 2010

Title : Senior Innovative Systems Architect/Sr. Staff Member

Group : Read Channels Research and Development.

Profile/Work Duties :

- Invent error-correcting codes, constrained codes, develop signal processing algorithms for detection and noise prediction, perform theoretical analysis for predicting the reliability of error-correcting codes on media recording channels.
- Support design and verification teams to handoff architectures through software modules and documentation.
- Write white papers for the customer.
- Establish research and development leadership for two-dimensional magnetic recording (TDMR) and solid state memories. Architect algorithms that are efficient from performance/area/power and speed perspectives. Actively involved in research proposals, patents and publications.
- Knowledge dissemination through teaching activities, seminars, invited talks and group discussions.

Western Digital, Lake Forest, California, U.S.A

Summer 2005

Title : Summer Intern

Group : Advanced Channels Division.

Work Duties : Developed algorithms for post-ECC modeling of magnetic recording channels using hidden Markov models to analyze sector failure rates. The prediction model was theoretically solid and showed good correlation with real data from hard drives.

Broadcom Corporation, Bangalore, India

June 2001 - Dec 2001

Title : Senior Design Engineer

Group : Digital Video Engineering.

Work Duties :

- Developed efficient algorithms for real time decoding of General Instruments' HITS streams for Personal Video Recording (PVR) feature that was put to actual Silicon on Broadcom chips.
- Software and debugging support for algorithm handoff.

Infosys Technologies Ltd, Bangalore, India

1997 - 1999

Title : Software Design Engineer

Group : Nortel Networks - DMS 100 Switches and Spectrum

Work : Switching communications software for NORTEL DMS-100 switches and line timing synchronization for spectrum peripheral module.

Honors, Awards and Professional Distinctions

- Bharat jyoti and Rajiv Gandhi excellence awards - 2014 (Declined).
- Western digital inventor awards - 2012.
- Marquis who's who in science and technology - 2011.

- Senior member, IEEE - 2011.
- Several patent awards and performance incentives at STMicroelectronics 2006-2010 (7 patents filed).
- Infosys-Nortel project of the year award - 1999.
- Best student paper award from the institute of electronics and telecommunication engineers, India, 1997.
- Awarded by the University of Mysore for securing 5th rank for the university in electronics and communication engineering - 1997.
- National talent search scholar - 1991-97. Awarded by national council of educational research and training - Government of India. Ranked 8th at Karnataka state level.
- Awarded by the chief minister of the state for securing 15th rank for the state out of nearly 500,000 - State Government of Karnataka, India - 1991.
- Best boy award (out of nearly 1000 students), Vijaya high school, Bangalore 1991. Several academic achievement prizes during high school and pre-high school days.

Professional Activities: Editor/Technical Paper Reviews

- Editor, IETE Review Journal, Taylor and Francis Publishers.
- Reviewer for IEEE Transactions on communications, signal processing, information theory, magnetics, communication letters, JSAC, circuits and systems-I.
- Reviewer for Optical engineering, Journal for electronic imaging - SPIE.
- Reviewer for EURASIP - Journal of applied signal processing.
- Reviewer for Journal on real time imaging - Springer-verlag.
- Technical program committee member: IEEE international conferences: ISIT 2014, Globecom 2012-2015, ICC 2013-2015, ICNC 2013, ICCVE 2012-2014, CONECCT 2013-2014, SPCOM 2014 (Publications chair).

Professional Activities: Research Grant Reviews

- Reviewer for American mathematical society research proposals.
- Reviewer for IDEMA-ASTC signal processing proposals.

Professional Activities: Leadership initiatives

- Chairman, Photonic Detection, Member, Optical society of America.
- Technology committee chairman for signal processing and channels research within advanced storage technology consortium (ASTC) under international disk drive equipment and materials association (IDEMA) (2011-2012). Western digital representative as a member of the technology committee (2012). Co-chair for the overall technological committee (2012).
- Senior member, IEEE communications and information theory society.

Professional Activities: Academic Services

- Faculty fellow from Indian national academy of sciences for recruiting and mentoring talented under graduate students across the country as part of internships.
- Faculty co-ordinator for M.Tech 2013-2015 within ESE department at IISc.
- Invited examiner for thesis defense within IISc, and in various universities at the national level.

Post-Doctoral Researchers

- Dr. Yiming Chen (Western Digital Corporation) (Summer 2011). Current position as principal engineer within Western Digital advanced channels division, U.S.A.

Doctoral Students

- Chaitanya Kumar Matcha: *“Two-dimensional signal processing and modulation coding for data storage,”* (Ph.D, ESE department, IISc) (Fall 2013, ongoing)
- Shounak Roy: *“Two-dimensional error correction for storage channels,”* (Ph.D, ESE department, IISc) (Fall 2013, ongoing)
- Ankur Raina: *“Information theory and signal processing for quantum secure channels,”* (Ph.D, ESE department, IISc) (Fall 2013, ongoing)
- Prayag Gowgi: *“Spatio-temporal memories and pattern formation,”* (Ph.D, ESE department, IISc) (Fall 2013, ongoing)

Masters Students

- Brijesh P. Reddy: *“Two-dimensional timing recovery using phase-locked loops,”* (M.Tech, ESE department, IISc) (Graduated summer 2014, Processor design engineer at Applied Microcircuits Corporation, Bangalore)
- Arijit Mondal *“Design of a min-sum LDPC decoder for error correction,”* (M.E Microelectronics, ESE department, IISc) (Graduated summer 2014, Research assistant at IISc within PNSIL)
- Nithin Raveendran: *“Analysis of the loopy belief propagation algorithm over short cycles,”* (M.Sc, ESE department, IISc) (Fall 2012, ongoing)
- Saugata Datta *“Design of an asynchronous Viterbi detector,”* (M.E Microelectronics, ECE department, IISc) (Fall 2013, ongoing)

Undergraduate Interns/project assistants

- Praveen Kumar: Fall 2012-present (Project Assistant, Music signal processing)
- Eeshan Modak: Spring 2014-present (Project Assistant, Timing recovery methods)
- Gauri Jagatap: Summer intern 2013 (Quantum security)

- Prakash Roy: Summer intern 2014 (Soft-output Viterbi algorithm)
- Mounika Manukonda: Winter intern 2014 (Quantum Security)

Funded Research/Grant Awards

- **Chief-PI: Modeling, signal processing and coding for two-dimensional magnetic recording.**
Funding Source: Department of electronics and information technology, 48 Lakhs (\$100K), (2014-2017),
- **Chief-PI: Timing recovery techniques and architectures for two-dimensional data storage channels.**
Funding Source: Department of Science and technology, 37 Lakhs, (\$74K) (2013-2016),
- **Chief-PI: Classical and quantum LDPC codes: Constructions and bounds**
Funding Source: IISc space technology cell, 20 Lakhs, (\$40K) (2012-2015),
- **Chief-PI: Start up grant**
Funding Source: IISc, 34 Lakhs, (\$74K) (2012-2013),
- **Co-PI: LDPC codes with guaranteed error performance**
Funding Source: U. C. Discovery Grant, \$15,000, (2011-2012),

Books/Monographs

1. **Constrained coding and signal processing for holography**, Author: Shayan Garani Srinivasa, *VDM-Verlag*, ISBN-10: 3836467054, Germany, Aug. 2008.

Book Chapters

1. **Dynamic vector quantization of speech**, Title: **Advances in self-organizing maps**, Author: S. Garani and J. C. Principe, Editors: Nigel Allinson, Hujun Yin, Lesley Allinson and Jon Slack, *Springer-Verlag*, ISBN-10: 1852335114, London, July. 2001.

Journal Publications (Peer reviewed)

1. B. P. Reddy, S. G. Srinivasa, and S. Dahandeh “Timing recovery algorithms and architectures for two-dimensional magnetic recording systems,” Accepted to *IEEE. Trans. Magn.*, Mar. 2015.
2. S. G. Srinivasa, Y. Chen, and S. Dahandeh “A communication-theoretic framework for TDMR channel modeling: Performance evaluation of coding and signal processing methods,” *IEEE. Trans. Magn.*, Mar. 2014.
3. Y. Chen and S. G. Srinivasa “Joint self-iterating equalization and detection for two-dimensional intersymbol-interference channels,” *IEEE. Trans. Comm.*, vol. 61, no. 8, pp. 3219-3230, Aug. 2013.
4. S. G. Srinivasa, “Holographic imaging: Information recording and retrieval,” *Jour. Ind. Inst. Sci.*, vol. 93, no. 1, pp. 35-46, Mar. 2013. (Invited review article)
5. S. G. Srinivasa, O. Momtahan, A. Karbaschi, S. W. McLaughlin, F. Fekri, A. Adibi, “Volumetric storage limits and space volume multiplexing trade-offs for holographic channels,” *SPIE. Journal of Opt. Engineering*, vol. 49, no. 1, Jan. 2010.

6. S. G. Srinivasa and A. Weathers, "An efficient on-the-fly encoding algorithm for binary and finite-field LDPC codes," *IEEE. Comm. Lett.*, vol. 13, no. 11, pp. 853-855, Nov. 2009.
7. S. G. Srinivasa and S. W. McLaughlin, "Capacity bounds for two-dimensional asymmetric M-ary $(0, k)$ and (d, ∞) runlength-limited channels," *IEEE. Trans. Comm.*, vol. 57, no. 6, pp. 1584-1587, June. 2009.
8. S. G. Srinivasa, P. Lee and S. W. McLaughlin, "Post-error correcting code modeling of burst channels using hidden Markov models with applications to magnetic recording channels," *IEEE Trans. Magn.*, vol. 43, no. 2, pp. 572-579, Feb. 2007.
9. J. C. Principe, N. R. Euliano and S. Garani, "Principles and networks for self organization in space time," Special Issue of Journal of Neural Networks, *Elsevier Press*, vol. 15, pp. 1069-1083, Oct. 2002.

Patents

1. Channel constrained code aware interleavers, Patent No. 8,055,973, with Nicholas Richardson and Xinde Hu, 2011.
2. Interlaced iterative system design for 1K-byte block with 512 byte LDPC code words, Patent No. 8,255,768, with Xinde Hu, Sivagnanam Parthasarathy, Anthony Weathers and Richard Barndt, 2012.
3. Adaptive data dependent noise prediction, Patent No. 8,290,102, with Mustafa Kaynak, Stefano Valle and Sivagnanam Parthasarathy, 2012.
4. Encoding apparatus, system and method using LDPC codes, Patent No. 8,397,125, Sole inventor, March. 2013.
5. Methods and devices for two-dimensional iterative multi-track based MAP detection, Patent No. 8,582,223, with Yiming Chen, Nov. 2013.
6. Constrained on-the-fly interleaver address generation, Patent No. 8,625,220, with Sivagnanam Parthasarathy and Sudha Thipparthi, Jan. 2014.
7. Methods and devices for joint two-dimensional self-iterating equalization and detection, Patent No. 8,760,782, with Yiming Chen, June 2014.
8. Data storage device tracking log-likelihood ratio for a decoder based on past performance, Patent No. 8,856,615, with Anantha Raman Krishnan, Kent Anderson and Shafa Dahandeh, Oct. 2014.
9. Trapping set based LDPC code design, Inventors: Xinde Hu, Shayan G. Srinivasa, Anthony Weathers and Richard Barndt, *Patent Filed USPTO*, Dec. 2009.
10. Defect detection and correction in media recording channels using parity check codes, Inventors: Shayan G. Srinivasa and Sivagnanam Parthasarathy, *Patent Filed USPTO*, Aug. 2010.
11. Several patent applications filed at USPTO with Western Digital 2011-2012 (on advanced signal processing and error control coding algorithms and architectures, topics undisclosed until accepted as per confidentiality).
12. Machine based music synthesis, Inventors: Shayan G. Srinivasa, Harish Seshadri and Praveen Nandakumar, *Patent filed Indian PTO*, Dec. 2013.

International Conference Publications (Peer reviewed)

1. C. K. Matcha and S. G. Srinivasa, "Target design and low complexity signal detection for two dimensional magnetic recording," in *IEEE. Asia-Pacific Signal and Inform. Proc. Conf.*, Siem Reap, city of Angkor Wat, Cambodia, Dec. 2014.

2. C. K. Matcha, S. G. Srinivasa, S. M. Khatami and B. Vasić, “Two-dimensional noise-predictive maximum likelihood method for magnetic recording channels,” in *IEEE Intl. Symp. Inform. Theory and Appl.*, Melbourne, Oct. 2014.
3. A. Raina and S. G. Srinivasa, “Quantum communication over bit flip channels using entangled bipartite and tripartite states,” in *IEEE Proc. Fifty-second Allerton Conference on Computers, Control and Communications*, Urbana Champaign, U.S.A, Oct. 2014.
4. B. P. Reddy, S. G. Srinivasa, and S. Dahandeh, “Timing recovery algorithms and architectures for two-dimensional magnetic recording systems,” in *IEEE Magn. Record. Conf.*, Berkeley, Aug. 2014.
5. B. P. Reddy and S. G. Srinivasa, “Two-dimensional signal processing for timing recovery using PLLs for storage channels,” in *IEEE. China Summit and Intl. Conf. Signal and Inform. Processing*, Xi’an, July 2014.
6. N. Raveendran and S. G. Srinivasa, “A modified sum-product algorithm over graphs with isolated short cycles,” in *IEEE. Proc. Intl. Symp. Inform. Theory*, Honolulu, July 2014.
7. N. Raveendran and S. G. Srinivasa, “An analysis into the loopy belief propagation algorithm for short cycles,” in *IEEE. Proc. Intl. Conf. on Comm.*, Sydney, June 2014.
8. S. G. Srinivasa, “LDPC code designs based on \sqrt{I} matrices,” in *IEEE. Inform. Theory Appl. Workshop*, San Diego, Feb. 2014.
9. S. G. Srinivasa, Y. Chen and S. Dahandeh, “A communication-theoretic framework for TDMR channel modeling: Performance evaluation of coding and signal detection methods,” in *IEEE. Magn. Record. Conf.*, Tokyo, Aug. 2013.
10. S. G. Srinivasa and H. Seshadri, “Music and symbolic dynamics: The science behind an art,” in *IEEE. Inform. Theory Appl. Workshop*, San Diego, Feb. 2013.
11. Y. Chen and S. G. Srinivasa, “Performance-Complexity trade-offs of the 2-D iterative feedback signal detection algorithm,” in *IEEE. Intl. Conf. Computing, Networking and Communications*, San Diego, Jan. 2013.
12. A. Amiri, S. G. Srinivasa, and L. Dolecek, “Quantization, absorbing regions and practical message passing decoders,” in *IEEE. Proc. Asilomar Conference*, Monterey, Nov. 2012.
13. Y. Chen and S. G. Srinivasa, “Signal detection algorithms for two-dimensional intersymbol-interference channels,” in *IEEE. Proc. Intl. Symp. Inform. Theory*, Cambridge, July 2012.
14. J. Zhang, J. Wang, S. G. Srinivasa, and L. Dolecek, “Achieving flexibility in LDPC code design by absorbing set elimination,” in *IEEE. Proc. Asilomar Conference*, Monterey, Nov. 2011.
15. S. G. Srinivasa, O. Momtahan, A. Karbaschi, S. W. McLaughlin, A. Adibi, and F. Fekri, “M-ary, binary, and space-volume multiplexing trade-offs for holographic channels,” in *IEEE. Proc. Globecom*, San Fransisco, Nov. 2006.
16. S. G. Srinivasa and S. W. McLaughlin, “Capacity lower bounds for two-dimensional M-ary (d, ∞) and $(0, k)$ runlength-limited channels,” in *IEEE. Proc. Intl. Symp. Inform. Theory*, Seattle, pp. 1472-1476, July 2006.
17. S. G. Srinivasa, Patrick Lee, and S. W. McLaughlin, “Post-ECC modeling of magnetic recording channels using hidden Markov models,” in *IEEE. Proc. Intl. Conf. on Comm.*, Istanbul, pp. 1249-1254, June 2006.
18. S. G. Srinivasa and S. W. McLaughlin, “Capacity bounds and coding Schemes for two-dimensional asymmetric k-constrained runlength-limited arrays,” in *Proc. Forty-third Allerton Conference on Computers, Control and Communications.*, Illinois Univ. Press, Monticello, IL-U.S.A., Oct. 2005.
19. S. G. Srinivasa and S. W. McLaughlin, “Signal recovery due to rotational pixel misalignment,” in *IEEE. Proc. International Conference on Acoustics, Speech and Signal Processing*, pp. 121-124, Philadelphia, U.S.A., Mar. 2005.

20. S. G. Srinivasa and S. W. McLaughlin, "Enumeration algorithms for a class of $(d_1, \infty, d_2, \infty)$ RLL arrays: Capacity estimates and coding schemes," in *IEEE. Proc. Inform. Theory Workshop*, pp. 141-146, San Antonio, U.S.A., Oct. 2004.
21. S. G. Srinivasa and S. W. McLaughlin, "Algorithms for constructing a class of $(1, \infty, d, k)$ codes and estimates for capacity," in *Proc. Forty-first Allerton Conference on Computers, Control and Communications., Illinois Univ. Press*, pp. 867-875, Monticello, IL-U.S.A., Oct. 2003.
22. S. Garani and J. C. Principe, "Dynamic vector quantization of speech," *Proc. of Workshop on Self Organizing Maps.*, Springer-Verlag: London, pp. 238-245, July 2001.
23. S. Garani and J. C. Principe, "A spatio-temporal vector quantizer for missing samples reconstruction," in *IEEE. Proc. International Joint Conf. on Neural Netw.*, vol. 4, pp. 2913-2917, June 2001.

National Level Conference Publications

1. S. G. Srinivasa and Josyer G. V, "An image coding and compression algorithm through PRQMF banks and wavelets," *IETE National Conference, Mysore*, 1997. (Awarded best student paper)

Manuscripts in Review

1. Several original articles on various topics in review.

Select Academic and Industrial Talks and Presentations (International Invited Speaking Engagements)

1. 'Two-dimensional equalization and detection,' Department of electrical and computer engineering, University of California, San Diego, May 2013. (*IEEE* sponsored)
2. 'Music and symbolic dynamics,' Department of electrical and computer engineering at the University of California, San Diego and University of Arizona, Tucson, May 2013.
3. 'Information theory, signal processing and coding theory used in high-density optical recording,' Link-a-media Devices, Santa Clara, June 2010.
4. 'Research trends in advanced data storage research,' Department of Electrical Engineering, University of California, Irvine, Nov 2010.
5. 'Hidden Markov models in magnetic recording,' Center for Magnetic Recording Research, San Diego, Oct. 2008.
6. 'Signal processing for holography,' Broadcom Corporation, Longmont, Mar. 2006.
7. 'Post-ECC modeling,' Western Digital, Lake Forest, California, Aug. 2005.

Academic and Industrial Talks (National level Invited Speaking Engagements)

1. 'Data centers and microservers,' Samsung Data Storage Research Center, Bangalore, India, May 2014. (Industry invited lecture)

2. *'Music and symbolic dynamics: The science behind an art,'* CA Technologies, Bangalore, India, May 2014. (Industry invited lecture)
3. *'Mathematical techniques in signal processing and imaging,'* PSGTech, ECE dept, Coimbatore, India, Oct. 2013. (part of faculty quality improvement program)
4. *'Stochastic processes in engineering,'* RVCE, Mathematics dept, Bangalore, India, July. 2013. (part of faculty quality improvement program)
5. *'Linear algebra in biology,'* PESIT, Bangalore, ECE dept, India, July. 2013. (part of faculty quality improvement program)
6. *'Constrained coding and signal processing for holography,'* Texas Instruments Bangalore, Oct. 2005.
7. *'Signal modeling and representation,'* Deepthi Electronics and Optics Ltd, Bangalore, India, Aug. 2003.
8. *'Multirate signal processing and sampling rate architectures,'* Broadcom Corporation, Bangalore, India, Dec. 2001.

Courses Offered/Taught

1. Selected topics in Markov chains and optimization (New graduate level course introduced with Prof. Joy Kuri), IISc-Bangalore, Fall 2014.
2. Signal processing for data recording channels (New graduate level course introduced), IISc-Bangalore, Fall 2012. Taught during Fall 2012, Spring 2014.
3. Mathematical methods and techniques in signal processing (New graduate level course introduced), IISc-Bangalore, Fall 2013, 2014.
4. Seminars and research lectures on advanced topics to industrial R&D members.

Miscellaneous

1. South-indian classical vocalist sought after for concerts and ledems by various organizations.
2. Advanced level music teacher within the local Indian community.

Academic References

Available upon request.