Narayanan Rengaswamy

August 17, 2022

Assistant Professor (Tenure-Track)
Department of Electrical and Computer Engineering
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PROFESSIONAL EXPERIENCE

Assistant Professor (Tenure-Track), Aug. 2022 – Present
Department of Electrical and Computer Engineering, The University of Arizona, Tucson, AZ, USA

Postdoctoral Research Associate, Sep. 2020 – Aug. 2022
Department of Electrical and Computer Engineering, The University of Arizona, Tucson, AZ, USA

Research Associate, Jun. 2020 – Sep. 2020
Department of Electrical and Computer Engineering, Duke University, Durham, NC, USA

Graduate Research Intern, Jun. 2015 – Aug. 2015
Alcatel-Lucent Bell Labs, Stuttgart, Germany

Undergraduate Summer Intern, Jun. 2012 – Jul. 2012
Ericsson India Global Services Private Limited, Chennai, India

EDUCATION

Ph.D. in Electrical Engineering, Jan. 2016 – May 2020 *Cumulative GPA: 3.912/4*
Duke University, Durham, NC, USA

Dissertation: Classical Coding Approaches to Quantum Applications (https://www.youtube.com/watch?v=cvAcaujp7Wo)
Advisors: Prof. Henry D. Pfister and Prof. Robert Calderbank
Coursework: Quantum Information Science I & II, Quantum Error Correction and Architectures, Compressed Sensing, Information Theory and Statistical Mechanics, Convex Optimization, Probabilistic Machine Learning, Basic Analysis I, Detection and Estimation Theory

M.S. in Electrical Engineering, Aug. 2013 – Dec. 2015 *Cumulative GPA: 3.875/4*
Texas A&M University, College Station, TX, USA

Thesis: On Cyclic Polar Codes and the Burst Erasure Performance of Spatially-Coupled LDPC Codes
Advisors: Prof. Henry D. Pfister and Prof. Krishna R. Narayanan
Coursework: Channel Coding, Statistical Communication Theory, Information Theory, Advanced Channel Coding, Computer Communication and Networking, Wireless Communications

B.Tech. in Electronics and Communication Engineering, Jun. 2009 – May 2013 *Cumulative GPA: 9.70/10*
Amrita University, Coimbatore, Tamilnadu, India

Project: Wireless Electrocardiogram Monitoring for Cardiac Patients on Android Platform
Advisor: Prof. E. P. Sumesh
Advanced Coursework: Wireless Communications, OFDM for Broadband Wireless Communications, Agent Based Modeling, Pattern Recognition, Convex Optimization

HONORS and ACHIEVEMENTS

Talk at Quantum Information Processing (QIP) Conference, 2020 *Duke University*
– Our paper "On Optimality of CSS Codes for Transversal T" was one of the 73 out of 283 submissions that were accepted as talks in the esteemed QIP (2020) conference; Video: https://www.koushare.com/video/videoPreview/2001.0289

DAAD RISE Professional Scholarship, 2015 *Texas A&M University*
– One of the 34 scholarship recipients selected by the committee, among all the 184 applicants

– Funded the 3-month summer research internship in Alcatel-Lucent Bell Labs, Stuttgart, Germany

Top Rank in Undergraduate Studies, May 2013 *Amrita University*
– Ranked first in the college, third in the university (among 3 engineering campuses)

Ericsson Excel Certification in Telecommunications, 2012 *Amrita University*
– Attended leading Ericsson researcher's lectures, passed exam and completed an internship

Central Board of Secondary Education (CBSE) Merit Scholarship 2010-11 & 2011-12 *Amrita University*

Amrita TIDE Best Innovation Award, 2011-12 *Amrita University*
– As a team, developed an Integrated Village Development System; created a web portal for a job classifieds system
– Used Software Defined Radio (SDR) to demonstrate connectivity between places, with only partial internet dependence

FUNDING

National Science Foundation Grant No. 2106189 *University of Arizona*
– As a co-PI, developed the core ideas and wrote a major part of the proposal, *CIF: Medium: QODED: Quantum codes Optimized for the Dynamics between Encoded Computation and Decoding using Classical Coding Techniques*

National Science Foundation Grant No. 1908730 *Duke University*
– As a Ph.D. student, contributed to a major part of the proposal, *FET: Small: Improving Quantum Computing and Classical Communication using Discrete Sets of Unitary Matrices*

PATENTS

Processing Optical Signals Using Quantum-Enhanced Communications *University of Arizona*
– Filed a provisional application based on our work on Belief-Propagation with Quantum Messages (BPQM)

RESEARCH EXPERIENCE

Postdoctoral Research Associate, Prof. Bane Vasić's Group, Sep. 2020 – Aug. 2022 *University of Arizona*
– Worked on quantum error correction for quantum networks and quantum computing
– Actively involved in the NSF funded University of Arizona-lead Center for Quantum Networks (CQN) and the DoE funded Fermilab-lead Superconducting Quantum Materials and Systems (SQMS) center
– Developed a quantum error correction based protocol for distilling GHZ states (entanglement distillation)
– Demonstrated the advantages of concatenating the Gottesman-Kitaev-Preskill (GKP) code with an outer quantum low-density parity-check (QLDPC) code by exploiting the GKP analog information in the outer code's iterative decoder

Research Assistant/Associate, Prof. Henry Pfister's Group, Jan. 2016 – Sep. 2020 *Duke University*
– Worked on problems in quantum computation and quantum information
– Developed a systematic framework for synthesizing logical Clifford operators for arbitrary stabilizer codes
– Constructed an almost optimal size unitary 2-design using the symmetries of classical Kerdock codes
– Software implementations of all algorithms available at `https://github.com/nrenga/symplectic-arxiv18a`
– Developed a simple characterization of certain diagonal unitaries in the Clifford hierarchy
– Used this to characterize all stabilizer codes that support a given pattern of T and $T^\dagger$ gates on the physical qubits; proved a corollary that among all non-degenerate stabilizer codes that have this property, CSS codes are optimal
– Carefully analyzed a recently proposed belief propagation algorithm for pure-state channels that passes quantum messages; using a 5-bit code as an example, performed calculations on the involved density matrices to show that this algorithm is quantum optimal, i.e., reaches the joint Helstrom limit, even while making only single-qubit measurements
– Studied and prepared notes for understanding duality of channels and codes, based on a recent paper by Renes
– Conducted research on construction of deterministic compressed sensing matrices and recovery of large supports of unknown sparse vectors; demonstrated strong empirical evidence that Kerdock matrices outperform other constructions

Research Assistant, Prof. Henry Pfister's Group, Aug. 2014 – Dec. 2015 *Texas A&M University*
– Modified polar codes to produce cyclic polar codes of arbitrary blocklength, over appropriate Galois fields
– Achieved higher rates on the erasure channel than binary polar codes for a target block erasure rate

Research Assistant, Prof. Gregory Huff's Group, Jan. 2014 – Aug. 2014 *Texas A&M University*

– Worked on the MUSIC algorithm to triangulate and localize the origin of an ocean wave through its interaction with a network of buoy sensors; developed a C++ utility with Qt Creator IDE for field sensing and analysis

TEACHING

ECE 340A: Introduction to Communications, Fall 2022 *University of Arizona*

Lectures on Quantum Error Correction, Spring 2021 *University of Arizona*

Teaching Assistant, Error Correcting Codes, Fall 2017 *Duke University*

Teaching Assistant, Digital Audio Processing, Spring 2017 *Duke University*

Teaching Assistant, Capstone (Senior) Design, Spring and Fall 2015 *Texas A&M University*

Student Lectures, Channel Coding, Fall 2015 *Texas A&M University*

Several other one-off lectures, informal presentations, tutorial-type talks, and one-on-one teaching sessions at all institutions

SELECTED PROJECTS

Quantum Belief Propagation and CQ Polar Codes, Course Project, Spring 2019 *Duke University*
– Understood the recently introduced belief propagation algorithm that decodes classical binary linear codes on a pure-state channel by passing qubits as messages
– Constructed a 5-bit code example, performed full performance analysis for QBP on each bit, and compared to the optimal Helstrom strategy for each bit
– Summarized the connection to pure-loss optical channel and the capacity-achieving classical-quantum (CQ) polar codes

Decoding the Surface Code, Course Project, Fall 2018 *Duke University*
– Built the minimum-weight perfect matching (MWPM) decoder from scratch using MATLAB's optimization routines
– Verified the well-known surface code thresholds via extensive simulations
– Partially built the recently introduced "Blossom-Belief Propagation" algorithm for MWPM
– Report online: `https://dx.doi.org/10.13140/RG.2.2.27511.47522`

Efficient Classical Simulation of Quantum Circuits, Course Project, Fall 2018 *Duke University*
– Read and summarized the `CHP` simulator and the more recent stabilizer rank-based simulator
– Reviewed the symplectic representation of Clifford group and used it to succinctly describe the `CHP` simulator
– Report online: `https://dx.doi.org/10.13140/RG.2.2.20800.58887`

Hands On, Course Project, Fall 2013 *Texas A&M University*
– As a team, developed a device for testing coordination of both hands simultaneously
– Developed a GUI using Qt Creator IDE to receive and visualize Inertial Measurement Unit (IMU) data real-time
– Performed real-time testing with voluntary participants on Demo Day

Wireless Electrocardiogram (ECG) Monitoring, B.Tech. Project, Jul. 2012 – May 2013 *Amrita University*
– As a team, built hardware to transmit ECG (input from a reliable, mobile ECG extractor) to phone over Bluetooth
– Developed an Android application to receive signals from hardware in real-time and display it along with key parameters
– Processed the signals using the Pan-Tompkins algorithm to detect key parameters, and raised alerts when necessary via the Short Message Service (SMS)

PROFESSIONAL ACTIVITIES

Posters Program Committee, 2022 IEEE International Conference on Quantum Computing and Engineering (QCE22)

Organizing Committee, 2022 NSF-ERC Center for Quantum Networks (CQN) Summer Retreat Workshop

Quantum Error Correction Working Group Meetings, Oct. 2020 – Present *University of Arizona*
– Organizing weekly meetings to discuss quantum error correction for the NSF Center for Quantum Networks

– Presented on several topics including our work on entanglement distillation

Project Manager for Duke Opportunities in Math (DOmath), Jun. 2018 – Jul. 2018 *Duke University*
– Mentored 3 students in a two-month project performing randomized benchmarking on IBM's *ibmqx4* device.
Project lead by Prof. Robert Calderbank and Prof. Henry Pfister. Report: `https://math.duke.edu/domath2018`

Quantum Group Meetings, Mar. 2017 – Aug. 2020 *Duke University*
– Organized weekly meetings on topics related to quantum information, computation, communications, algorithms
– Presented papers and my notes on several topics of interest, most recently on our work on codes that support T gates

North American School of Information Theory, June 2016 *Duke University*
– Assisted in organizing the summer school, handled monetary responsibilities
– Developed an information-theory crossword puzzle (with a colleague) to illustrate iterative decoding

Workshop on Software Defined Radio, Aug. 2012 *Amrita University*
– Learned to work with the Universal Software Radio Peripheral (USRP) Kit
– Developed simple communications system modules in GNU Radio Companion software

Member of IEEE, since May 2020

Graduate Student Member of IEEE, Nov. 2015 – May 2020

Reviewer for Journals (in **bold**) **and Conferences** (in *italics*)**:**

IEEE Information Theory Workshop, 2022

IEEE International Symposium on Information Theory, 2022

Quantum Information Processing, 2021

Physical Review A, since 2021

IEEE Transactions on Quantum Engineering, since 2021

IEEE Access, since 2021

IEEE Transactions on Communications, since 2020

Proceedings of the Royal Society A, since 2020

Quantum Science and Technology, since 2020

IEEE Information Theory Workshop, 2020

IEEE International Symposium on Information Theory, 2020

Quantum, since 2019

IEEE Transactions on Vehicular Technology, since 2019

IEEE Information Theory Workshop, 2018

IEEE International Symposium on Information Theory, 2018

IEEE Transactions on Information Theory, since 2016

THESES

2. **N. R.**, "Classical Coding Approaches to Quantum Applications," Ph.D. Dissertation, Duke University, 2020. [Online]. Available: `http://arxiv.org/abs/2004.06834`.

1. **N. R.**, "On Cyclic Polar Codes and the Burst Erasure Performance of Spatially-Coupled LDPC Codes," Master's thesis, Texas A&M University, 2015. [Online]. Available: http://arxiv.org/abs/2004.06875.

PEER-REVIEWED JOURNAL PAPERS

11. N. Raveendran, **N. R.**, F. Rozpędek, A. Raina, L. Jiang, and B. Vasić, "Finite rate QLDPC-GKP coding scheme that surpasses the CSS Hamming bound," *Quantum*, vol. 6, p. 767, Jul. 2022. [Online]. Available: https://arxiv.org/abs/2111.07029

10. S. Brandsen, M. Lian, K. D. Stubbs, **N. R.**, and H. D. Pfister, "Adaptive procedures for discriminating between arbitrary tensor-product quantum states," *Phys. Rev. A*, vol. 106, no. 1, p. 012408, 2022.

9. X. Tan, **N. R.**, and R. Calderbank, "Approximate unitary 3-designs from transvection Markov chains," *Designs, Codes and Cryptography*, pp. 1–24, 2022. [Online]. Available: https://arxiv.org/abs/2011.00128

8. J. Hu, Q. Liang, **N. R.**, and R. Calderbank, "Mitigating coherent noise by balancing weight-2 Z-stabilizers," *accepted to IEEE Trans. Inf. Theory*, 2021. [Online]. Available: https://arxiv.org/abs/2011.00197

7. **N. R.**, K. P. Seshadreesan, S. Guha, and H. D. Pfister, "Belief propagation with quantum messages for quantum-enhanced classical communications," *npj Quantum Inf.*, vol. 7, no. 1, p. 97, 2021. [Online]. Available: http://arxiv.org/abs/2003.04356

6. T. Pllaha, **N. R.**, O. Tirkkonen, and R. Calderbank, "Un-Weyl-ing the Clifford Hierarchy," *Quantum*, vol. 4, p. 370, 2020. [Online]. Available: http://arxiv.org/abs/2006.14040

5. **N. R.**, R. Calderbank, M. Newman, and H. D. Pfister, "On optimality of CSS codes for transversal T," *IEEE J. Sel. Areas in Inf. Theory*, vol. 1, no. 2, pp. 499–514, 2020. [Online]. Available: http://arxiv.org/abs/1910.09333. Presented at *QIP 2020* as a talk.

4. **N. R.**, R. Calderbank, S. Kadhe, and H. D. Pfister, "Logical Clifford synthesis for stabilizer codes," *IEEE Trans. Quantum Engg.*, vol. 1, 2020. [Online]. Available: http://arxiv.org/abs/1907.00310

3. T. Can, **N. R.**, R. Calderbank, and H. D. Pfister, "Kerdock Codes Determine Unitary 2-Designs," *IEEE Trans. Inform. Theory*, vol. 66, no. 10, pp. 6104–6120, 2020. [Online]. Available: http://arxiv.org/abs/1904.07842

2. **N. R.**, R. Calderbank, and H. D. Pfister, "Unifying the Clifford hierarchy via symmetric matrices over rings," *Phys. Rev. A*, vol. 100, no. 2, p. 022304, 2019. [Online]. Available: http://arxiv.org/abs/1902.04022

1. V. Aref, **N. R.**, and L. Schmalen, "Finite-Length Analysis of Spatially-Coupled Regular LDPC Ensembles on Burst-Erasure Channels," *IEEE Trans. Inform. Theory*, vol. 64, no. 5, pp. 3431 – 3449, 2018. [Online]. Available: https://arxiv.org/abs/1611.08267.

PREPRINTS

4. **N. R.**, A. Raina, N. Raveendran, and B. Vasić, "Distilling GHZ States using Stabilizer Codes," *arXiv preprint arXiv:2109.06248*, 2021. [Online]. Available: https://arxiv.org/abs/2109.06248

3. **N. R.** and H. D. Pfister, "A semiclassical proof of duality between the classical BSC and the quantum PSC," *arXiv preprint arXiv:2103.09225*, 2021. [Online]. Available: http://arxiv.org/abs/2103.09225

2. Y. Ouyang and **N. R.**, "Weight distribution of classical codes influences robust quantum metrology," *arXiv preprint arXiv:2007.02859*, 2020. [Online]. Available: http://arxiv.org/abs/2007.02859

1. **N. R.**, R. Calderbank, S. Kadhe, and H. D. Pfister, "Synthesis of Logical Clifford Operators via Symplectic Geometry," *arXiv preprint arXiv:1803.06987*, 2018. [Online]. Available: http://arxiv.org/abs/1803.06987

PEER-REVIEWED CONFERENCE PAPERS

12. N. Raveendran, **N. R**, A. K. Pradhan, and B. Vasić, "Soft syndrome decoding of quantum LDPC codes for joint correction of data and syndrome errors," in *IEEE International Conference on Quantum Computing and Engineering (QCE)*, Sep. 2022. [Online]. Available: https://arxiv.org/abs/2205.02341

11. J. Hu, Q. Liang, **N. R.**, and R. Calderbank, "CSS Codes that are Oblivious to Coherent Noise," in *Proc. IEEE Int. Symp. Inform. Theory*, 2021, pp. 1481–1486.

10. **N. R.** and H. D. Pfister, "On the Duality Between the BSC and Quantum PSC," in *Proc. IEEE Int. Symp. Inform. Theory*, 2021, pp. 2232–2237.

9. **N. R.**, K. P. Seshadreesan, S. Guha, and H. Pfister, "A Belief Propagation-based Quantum Joint-Detection Receiver for Superadditive Optical Communications," in *Conf. Lasers Electro-Optics*, 2021, p. FW3N.8. [Online]. Available: `https://www.osapublishing.org/abstract.cfm?uri=CLEO{_}QELS-2021-FW3N.8`

8. S. Brandsen, M. Lian, K. D. Stubbs, **N. R.**, and H. D. Pfister, "Adaptive procedures for discriminating between arbitrary tensor-product quantum states," in *Proc. IEEE Int. Symp. Inform. Theory*, 2020, pp. 1933–1938. [Online]. Available: `http://arxiv.org/abs/1912.05087`

7. **N. R.**, K. P. Seshadreesan, S. Guha, and H. D. Pfister, "Quantum advantage via qubit belief propagation," in *Proc. IEEE Int. Symp. Inform. Theory*, 2020, pp. 1824–1829. Video: `https://www.youtube.com/watch?v=L38YlINdnq0`

6. **N. R.**, R. Calderbank, M. Newman, and H. D. Pfister, "Classical coding problem from transversal T gates," in *Proc. IEEE Int. Symp. Inform. Theory*, 2020, pp. 1891–1896. [Online]. Available: `http://arxiv.org/abs/2001.04887`. Video: `https://www.youtube.com/watch?v=E7v1k6dW0gQ`

5. T. Can, **N. R.**, R. Calderbank, and H. D. Pfister, "Kerdock Codes Determine Unitary 2-Designs," in *Proc. IEEE Int. Symp. Inform. Theory*, pp. 2908–2912, July 2019.

4. **N. R.**, R. Calderbank, S. Kadhe, and H. D. Pfister, "Synthesis of Logical Clifford Operators via Symplectic Geometry," in *Proc. IEEE Int. Symp. Inform. Theory*, pp. 791–795, June 2018.

3. V. Aref, **N. R.**, and L. Schmalen, "Spatially Coupled LDPC Codes Affected by a Single Random Burst of Erasures," in *Proc. Int. Symp. on Turbo Codes & Iterative Inform. Process.*, pp. 166–170, Sep. 2016. [Online]. Available: `https://arxiv.org/abs/1607.00918`.

2. **N. R.**, L. Schmalen, and V. Aref, "On the Burst Erasure Correctability of Spatially Coupled LDPC Ensembles," in *Proc. IEEE Intl. Zurich Seminar on Commun.*, pp. 155–159, March 2016.

1. **N. R.** and H. D. Pfister, "Cyclic Polar Codes," in *Proc. IEEE Int. Symp. Inform. Theory*, pp. 1287–1291, June 2015.

VISITS, TALKS, POSTERS AND WORKSHOPS

29. **Invited Talk** "NSF-ERC Center for Quantum Networks: An Overview", *Joint Meeting with Quantinuum and the United States Air Force Academy*, Denver, CO, Aug. 11, 2022.

28. **Invited Talk** (jointly with Nithin Raveendran) – "Tutorial on Quantum Error Correction and Recent Developments in Quantum LDPC Codes", *Information Theory and Applications (ITA) Workshop*, May 23, 2022.

27. **Invited Talk** (jointly with Nithin Raveendran and Filip Rozpędek) – "Finite Rate QLDPC-GKP Coding Scheme that Surpasses the CSS Hamming Bound", *IBM Quantum Network Colloquium*, Apr. 14, 2022.

26. Talk – "Distilling GHZ States using Stabilizer Codes", *Beyond IID in Information Theory Workshop*, Sep. 27 – Oct. 1, 2021. Video: `https://www.youtube.com/watch?v=Bl8BKnuntTA`

25. Talk – "Distilling GHZ States using Stabilizer Codes", *Quantum Error Correction Meeting*, Duke University, Sep. 16, 2021.

24. **Invited Talk** – "Mitigating Coherent Noise in Quantum Computing using the Classical MacWilliams Identities", *CCSP Seminar*, University of Maryland, Apr. 8, 2021. Video: `https://www.youtube.com/watch?v=PFr6Ux1GMbg`

23. **Invited Talk** – "Error Correction for Quantum Computing and Communications", *Modeling, Computation, Nonlinearity, Randomness and Waves Seminar*, University of Arizona, Apr. 1, 2021. Video: `https://arizona.hosted.panopto.com/Panopto/Pages/Viewer.aspx?id=d759cd00-b0c0-4068-bc90-ad08012c18d6`

22. **Invited Talk** – "What is Quantum Computing and How does Quantum Error Correction Work?", *Math/Stat Virtual Tea*, Mount Holyoke College, Sep. 17, 2020. Video: `https://www.youtube.com/watch?v=XmsgxawVceQ`

21. **Invited Talk** – "Quantum Error Correction: Overview and Connections to Classical Coding Theory", *Seminar*, Indian Institute of Technology Hyderabad and International Institute of Information Technology Hyderabad, Jun. 17-18, 2020. Videos: `https://www.youtube.com/watch?v=dAVUA2iiyK0` , `https://www.youtube.com/watch?v=1LysQ_h8pgg`

20. **Ph.D. Defense Talk** – "Classical Coding Approaches to Quantum Applications", *Department of Electrical and Computer Engineering*, Duke University, Mar. 18, 2020. Video: `https://www.youtube.com/watch?v=cvAcaujp7Wo`

19. Talk – "Classical Coding Approaches to Quantum Applications", *Institute for Quantum Information (IQI) Seminar*, California Institute of Technology (Host: Prof. John Preskill), Feb. 11, 2020, and *Quantum Information Seminar*, Google Quantum AI, Venice, CA (Host: Dr. Jarrod McClean), Feb. 12, 2020.

18. **Invited Talk and Poster** – Graduation Day Talk and Poster at the *Information Theory and Applications Workshop (ITA)*, San Diego, USA, Feb. 2-7, 2020.

17. **Contributed Talk** – "On Optimality of CSS Codes for Transversal T", *23rd Annual Conference on Quantum Information Processing (QIP)*, Shenzhen, China, Jan. 7, 2020. Video: `https://www.koushare.com/video/videoPreview/2001.0289`

16. Talk – "On Optimality of CSS Codes for Transversal T", *Institut Quantique Seminar*, Université de Sherbrooke (Host: Prof. David Poulin), Oct. 28, 2019, and *Institute for Quantum Computing (IQC) Seminar*, University of Waterloo (Host: Prof. David Gosset), Nov. 5, 2019.

15. Visit – Prof. Jean-Pierre Tillich, *INRIA Research Center*, Paris, July 22-25, 2019.

14. Talk – "Integer Symmetric Diagonal (ISD) Gates and Codes that Support Physical T Gates", *Quantum Information Seminar*, Technical University of Delft (Host: Prof. Barbara Terhal), July 16, 2019, and University of Sheffield (Host: Prof. Earl Campbell), Aug. 5, 2019.

13. Poster – "Unifying the Clifford Hierarchy via Symmetric Matrices over Rings", *14th Conference on the Theory of Quantum Computation, Communication and Cryptography*, University of Maryland, Jun. 3-7, 2019, and *5th International Conference on Quantum Error Correction*, Senate House, London, July 29 – Aug. 2, 2019.

12. Poster – "Kerdock Codes Determine Unitary 2-Designs", *22nd Annual Conference on Quantum Information Processing*, University of Colorado Boulder, Jan. 14-18, 2019, and *14th Conference on the Theory of Quantum Computation, Communication and Cryptography*, University of Maryland, Jun. 3-7, 2019.

11. Poster – "Symplectic Matrices for Logical Clifford Synthesis and Diagonal Unitaries in the Clifford Hierarchy", *22nd Annual Conference on Quantum Information Processing*, University of Colorado Boulder, Jan. 14-18, 2019.

10. Poster – "Synthesis of Logical Clifford Operators via Symplectic Geometry", *13th Conference on the Theory of Quantum Computation, Communication and Cryptography*, University of Technology Sydney, Jul. 14-20, 2018.

9. Poster – "Synthesis of Logical Operators for Quantum Computers using Stabilizer Codes", *North American School of Information Theory*, Texas A&M University, May 20-23, 2018.

8. Talk – "Synthesis of Logical Operators for Quantum Computers using Stabilizer Codes", *Seminar, Department of Electrical Engineering*, Indian Institute of Technology Madras (Host: Prof. Pradeep Sarvepalli), Apr. 26, 2018.

7. Poster – "Logical Operators for CSS Codes: A Binary Perspective", *Duke IBM Day*, Duke University, Oct. 31, 2017.

6. Workshop – *Beyond I.I.D. in Information Theory*, National University of Singapore, Jul. 24-28, 2017.

5. Poster – "Deterministic Compressed Sensing and Recovery of Large Supports", *North American School of Information Theory*, Georgia Institute of Technology, Jun. 6-9, 2017.

4. Workshop – *Communications, Inference, and Computing in Molecular and Biological Systems*, University of Southern California, Dec. 3-4, 2015.

3. Talk – "The Burst Erasure Correctability of Spatially Coupled LDPC Ensembles", *Information Sciences and Systems Seminar*, Texas A&M University, Nov. 4, 2015.

2. Talk – "Cyclic Polar Codes", *Information Sciences and Systems Symposium*, Texas A&M University, Oct. 19, 2015.

1. Poster – "Cyclic Polar Codes: How to Achieve Higher Rates than Binary Polar Codes at Finite Blocklengths?", *Eighth Annual Winedale Workshop*, Round Top, Texas, Oct. 9, 2015.

REFERENCES

1. **Prof. Henry D. Pfister**, Department of ECE, Duke University, `pfister.ee.duke.edu`

2. **Prof. Robert Calderbank**, Department of ECE, Duke University, `ece.duke.edu/faculty/robert-calderbank`

3. **Prof. Bane Vasić**, Department of ECE, University of Arizona, `vasic-error-correction-laboratory.silicon-studio.com/index.html`

4. **Prof. Kaushik Seshadreesan**, Department of Informatics and Networked Systems, University of Pittsburgh, dins.pitt.edu/people/kaushik-p-seshadreesan

5. **Prof. Liang Jiang**, Pritzker School of Molecular Engineering, University of Chicago, pme.uchicago.edu/group/jiang-group

6. **Prof. Kenneth R. Brown**, Department of ECE, Duke University, ece.duke.edu/faculty/kenneth-brown