Vahid Nourozi, PhD

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EDUCATION

New Mexico State University (NMSU), Las Cruces, NM, USA — 2023 – Present

- Ph.D. Student in Electronic Engineering
  - Research areas: Quantum error correction and quantum computing
  - Supervisor: Prof. David G. M. Mitchell
  - Relevant Coursework: Quantum error correction, Coding theory, 6G, Signal Systems, Channel Communication

Amir Kabir University of Technology (Tehran Polytechnic), Tehran, Iran — 2016 – 2021

- Ph.D. in Mathematics
  - Thesis: The Rank Cartier Operator and Linear System on Curves
  - Research areas: Algebraic Geometry and Coding theory, Secure Channel
  - Supervisors: Prof. Farhad Rahmati and Prof. Saeed Tafazolian

Universidade Estadual de Campinas (Unicamp), Campinas, Brazil — 2019 – 2021

- Ph.D. Sandwich in Mathematics
  - Thesis: The Rank Cartier Operator and Linear System on Curves
  - Research areas: Algebraic Geometry and Coding theory
  - Supervisor: Prof. Saeed Tafazolian

Tarbiat Modares University, Tehran, Iran — 2012 – 2014

- M.S. in Mathematics
  - Thesis: PP-properties in Hurwitz series ring
  - Research area: Non-commutative Algebra
  - Supervisor: Prof. Ahmad Moussavi

Tafresh University, Tafresh, Iran — 2008 – 2012

- B.Sc. in Mathematics
  - Research area: Pure Mathematics
  - Supervisor: Prof. Ali Parsiyan

RESEARCH INTERESTS

- Quantum error correction
- 6G, Channel Communication
- Communication Systems
- Machine learning
- Coding theory, LDPC codes, Polar codes
- Algebraic Geometry Codes
- Quantum Algorithm

PUBLICATIONS

[1] **V. Nourozi**, D. G. M. Mitchell. Linear Scaling Quantum LDPC Codes via Balanced Products. Preprint. (2024)

[2] **V. Nourozi**. Quantum Error Correction with Goppa Codes from Maximal Curves: Design, Simulation, and Performance, to appear Discrete Mathematics, Algorithms and Applications (2024)

[3] **V. Nourozi**. Application of the Cartier Operator in Coding Theory. Finite Fields and Their Applications, 96, 102419. (2024)

[4] **V. Nourozi** and B. Mosallaei. The a-number of $y^{q^2+q+1} = x^{q^2+1} + x^q$ over finite fields. Preprint. (2024)

[5] **V. Nourozi** and Farhad Rahmati, The Rank of the Cartier Operator on Picard Curves, Discrete Mathematics, Algorithms and Applications, 2450028. (2023)

[6] **V. Nourozi**, Goppa code and quantum stabilizer codes from plane curves given by separated polynomials, Under review in the Finite Fields and Their Applications. (2023)

[7] V. Nourozi and S. Tafazolian, The a-number of maximal curves of third largest genus, AUT Journal of Mathematics and Computing 3(1), 11-16 (2022)

[8] **V. Nourozi** and F. Rahmati, The Rank of the Cartier operator on a certain F_q-Maximal function fields. Missouri Journal of Mathematical Sciences 34 (2), 184-190 (2022)

[9] **V. Nourozi**, F. Rahmati and S. Tafazolian, The a-number of Certain Hyperelliptic Curve. Iranian Journal of Science and Technology, Transactions A: Science, 1-5 (2022)

[10] **V. Nourozi**, S. Tafazolian and F. Rahmati, The a-number of Certain Maximal Curve. Transactions on Combinatorics, 10(2), pp. 121-128. (2021)

[11] **V. Nourozi** and F. Rahmati, The a-number of plane curves given by separated polynomials, Submitted. (2021)

[12] **V. Nourozi** and F. Rahmati, Goppa code and quantum stabilizer codes from plane curves given by separated polynomials. Submitted. (2021)

[13] V. Nourozi and F. Rahmati, The a-number of special Maximal Curves. Submitted. (2021)

[14] **V. Nourozi**, F. Rahmati and M. Ahmadi, McCoy property of Hurwitz series rings. Asian-European Journal of Mathematics 14 (06), 2150105. (2020)

[15] **V. Nourozi** and F. Rahmati, Multivariate Ore Polynomials for Key Exchange Cryptographic Protocols. The Third Conference on Computational Group Theory, Computational Number Theory and Applications, University of Kashan. (2019)

[16] **V. Nourozi** and M. Afshar, Quantum Codes from Hyperelliptic Curves, Southeast Asian Bulletin of Mathematics 43 (3), 395–400. (2019)

[17] **V. Nourozi**, A. Moussavi and M. Ahmadi On Nilpotent Elements of Skew Hurwitz Polynomial Rings. Southeast Asian Bulletin of Mathematics, 41 (2), 239-248. (2017)

[18] M. Ahmadi, A. Moussavi and V. Nourozi, Nilradicals of skew Hurwitz series of rings, Le Matematiche 70 (1), 125-136. (2015)

[19] **V. Nourozi**, A. Moussavi and K. Sabzipour, Nil α-Skew Armendariz property in skew Hurwitz polynomial rings, Electronic Journal of Mathematics and Its Applications. 1 (1), 14-20. (2015)

[20] M. Ahmadi, A. Moussavi and **V. Nourozi**, On skew Hurwitz serieswise Armendariz rings, Asian-European Journal of Mathematics 7 (03), 1450036. (2014)

[21] **V. Nourozi** and A. Moussavi, Armendariz ring of Hurwitz series type. The 23th seminar of algebra, Khansar. (2014)

GRANTS

- ORNL National Lab, US Quantum Information Science, Oak Ridge National Lab, U.S. (2024)
- PHY-1818914, NSF, Quantum Ideas Summer School, Duke Quantum Center. Duke University, U.S. (2024)
- DMS-2303977, NSF, for attending and talking in the 14th Southeastern Quantum structure in the Lie theory workshop. University of Virginia, U.S. (2024)
- Fall NSF Innovation Corps and awarded a scholarship for my innovative concept. Project: Application of Quantum LDPC codes in 5G and IoT, New Mexico State University, U.S. (2023)
- 314966/2018-8, TWAS-CNPq, Research on the Rank of Cartier operator. From Italy (TWAS) and Brazil (CNPq). (2019-2021)

TECHNICAL SKILLS

- **Programming Languages:** Python, C/C++, MATLAB
- **Quantum Computing Frameworks:** Qiskit, Cirq
- **High-Performance Computing:** CUDA, OpenMP
- **Quantum Error Correction:**
  - Stabilizer formalism
  - Topological codes: Surface codes Color codes Toric codes
  - CSS (Calderbank-Shor-Steane) codes
  - Quantum LDPC codes
  - Fault-tolerant quantum computation
  - Bacon-Shor codes
  - Quantum convolutional codes
  - Quantum error detection and correction circuits
  - Syndrome measurement and decoding algorithms
- **Quantum Algorithms:**
  - Grover's algorithm (quantum search)
  - Shor's algorithm (integer factorization)
  - Quantum Fourier Transform (QFT)
  - Quantum Phase Estimation (QPE)
  - Variational Quantum Eigensolver (VQE)
  - Quantum Approximate Optimization Algorithm (QAOA)
  - Quantum walks
  - Deutsch-Jozsa algorithm
  - Simon's algorithm
  - HHL algorithm (for linear systems of equations)
- Quantum Circuit Design and Optimization
- Quantum Error Mitigation Techniques

PROJECTS

- Quantum Error Correction Simulation
  - Implemented Shor's 9-qubit code and surface code for quantum error correction using Qiskit and custom C++ libraries
  - Analyzed performance of minimum-weight perfect matching and belief propagation decoding algorithms
- Large-Scale Quantum Circuit Simulation
  - Developed efficient simulation tools for quantum circuits with up to 50 qubits
  - Utilized parallel computing techniques to optimize performance on CPU/GPU clusters
  - Implemented in C++ and Python, achieving 100x speedup compared to naive implementation

SPECIALIZED KNOWLEDGE

- Quantum Algorithm Design: Grover's algorithm, Quantum Fourier Transform, VQE, QAOA
- Quantum Algorithms and Applications Experience
- Quantum Hardware Experience
- Collaborative and Communication Experience

SUMMER SCHOOLS

- Quantum Ideas Summer School, Duke Quantum Center, Duke University, U.S. (2024)
- US Quantum Information Science, Oak Ridge National Lab, U.S. (2024)
- IBM Quantum Challenge (2024)
- IBM Qiskit Global Summer School (2024)
- Womanium Quantum Program + AI and QWorld (2024)

CERTIFICATES

- **IBM** Qiskit Global Summer School 2024 - Quantum Excellence (2024)
- **IBM** Quantum Challenge 2024 Achievement, Advanced (2024)
- **IBM** Variational Algorithm Design (2024)
- **IBM** Quantum Business Foundation (2024)
- **IBM** Basic of Quantum Information (2024)
- **Ingenii** Quantum Machine Learning Fundamentals Course (2024)
- **Womanium** Quantum computing & Programing + AI program with Qiskit (2024)
- **IBM** Qiskit Global 2024 Achievement, Advanced (2024)
- **Womanium** Quantum Program + AI and QWorld, Quantum Algorithms (2024)
- **Womanium** Quantum Program + AI and QWorld, Quantum Annealing (2024)
- **Classiq Technologies**, Classiq Fundamentals Workshop (2024)
- **PennyLane** Quantum Machine Learning Challenge at the Womanium Global Quantum +AI Program 2024
- **QWorld** Quantum Computing & Programming with Qiskit using QWorld's introductory tutorial Bronze-Qiskit (2024)
- **Womanium** Womanium Global Quantum+AI Badge 2024 (Module-Based Track) (2024)
- **Womanium** Quantum Computing Hardware Certificate From Qubits to Quantum Computers (2024)
- **Classiq Technologies**, Advanced Proficiency in Quantum Algorithm Design (2024)

TALKS

- **Overcoming the Distance Barrier: QLDPC Codes with Linear Distance and Dimension**, 3rd edition of NERSC Quantum Days, Berkeley, California, U.S. (2024)
- **Quantum Structure in Algebraic Geometry**, In the 14th Southeastern Quantum Structure in the Lie Theory workshop. University of Virginia, U.S. (2024)

RESEARCH EXPERIENCES

- Study and research on quantum computing – Quantum error correction, Quantum Algorithm, Quantum computing, Quantum encoding and decoding
  - Supervisor: Prof. David Mitchell (New Mexico State University – U.S)
  - 2023 – Present
- Study and research on Algebraic Geometry – Cartier Operator, Coding theory, post-quantum cryptography, information theory
  - Supervisors: Prof. Farhad Rahmti (Amir Kabir University – Iran) and Prof. Saeed Tafazolian (Unicamp- Brazil)
  - 2016 – 2021
- Member of Blockchain group at Amir Kabir University of Technology
  - 2018
- Study and research on Non-commutative Algebra – Group Theory and power series
  - Supervisor: Prof. Ahmad Moussavi
  - 2012 – 2014

HONORS AWARDS

- Awarded Full Scholarship for graduate Program from The World Academy of Science (TWAS), and National Council for Scientific and Technological (CNPq) to study Ph.D Sandwich at Universidade Estadual de Campinas (Unicamp). (2019)
- Invited to the Ph.D interview without exam with master background. (2016)
- Awarded Full Scholarship for graduate Program from the ministry of science, research, and technology to study Ph.D at Amir Kabir University of technology. (2016)
- Top student among 42 graduate students. (2014)
- Awarded Full Scholarship for graduate Program from the ministry of science, research, and technology to study M.Sc. at Tarbiat Modares University. (2012)
- Awarded Full Scholarship for Undergraduate Program from the ministry of science, research and technology to study B.Sc. at Tafresh University. (2008)
- Ranked among top 1 percent in national university entrance exam among over 700,000 participants. (2008)

JOURNAL REVIEWER

- Transactions on Emerging Telecommunications Technologies
- American Mathematical Society
- IEEE Transactions on Information Theory
- IEEE Internet of Things (IoT)
- IEEE Transactions on Industrial Informatics
- Experimental Mathematics
- Discrete Mathematics, Algorithms and Applications
- The Journal of Supercomputing
- Peer-to-Peer Networking and Applications
- AUT Journal of Mathematics and Computing

LANGUAGE SKILLS

- Persian: Native
- English: Fluent
- Portuguese: Intermediate

SOCIETY AND COMMITTEE MEMBERSHIP

- American Mathematics Society: Association Member, Referee
- Iranian Mathematical Society: Association Member

OTHER

- Member of the mathematics team of Tafresh University in the country's student mathematics competitions. (2011)

INTERNET LINKS

- Google Scholar
- GitHub
- Publons
- LinkedIn
- ResearchGate
- Academia
- Personal Webpage

COMPUTER SKILLS

- Technical Software: Magma Software, Sage Software, LaTeX, Python, Qiskit, MATLAB, C/C++, Cirq