

RESEARCH SUMMARY

Strategist, research scientist and policy expert driven by the role next-generation technologies, particularly quantum computing, must increasingly play to address grand challenges and anticipate unforeseen future global risks. Quantum lead focusing on the development of theory, technologies and practice that draw from computing, information science and statistical physics to accelerate the maturation of Noisy Intermediate-Scale Quantum systems of today toward future scales of utility, including technology stacks, policy instruments and workforce development in the future quantum ecosystem. I strive to develop high-impact actionable insights toward robust solutions built to endure increasing complexity, volatility, uncertainty and ambiguity. My experience includes technical writing, public speaking, and delivering critical information strategically to decision makers under a wide variety of scenarios and constraints.

Broader research interests: fundamental physics, thermodynamics of open systems, probability and information theory, theory of computation, category and topos theory, artificial superintelligence, organization theory and practice, philosophy of science, evidence-based public policy making.

EDUCATION

2020 Ph.D. Doctor of Philosophy, Informatics and minor in Global Studies, University of Illinois Urbana-Champaign. Advisor: Eric Jakobsson[†] (MCB/Beckman/NCSA). Dissertation title: *Towards a unified view of complex multiscale stochastic systems: a generalized theory of interactions and related cyberinfrastructure as means for their universal and efficient investigation.*

2006 B.Sc. Bachelor of Science in Computer Science and Engineering, Costa Rica Institute of Technology. Supervisor: José Castro-Mora, Ph.D. Graduation project title: *Deployment of Beowulf clusters and applications for the first National eScience Grid Infrastructure.*

ACADEMIC POSITIONS

Fall 2023 - present Faculty Affiliate, Illinois Informatics, School of Information Sciences, University of Illinois Urbana-Champaign.

- Mentored students on the program
- Participated in outreach events for prospective students

Summer 2023 - present Senior Personnel MA2, Hybrid Quantum Architectures and Networks, Grainger College of Engineering, University of Illinois Urbana-Champaign.

- Developed research proposals on quantum computing stacks for multiple architectures
- Performed research on message passing models for distributed quantum computing

Spring 2023 - present Faculty Affiliate, Illinois Quantum Science and Technology Center (IQUIST), University of Illinois Urbana-Champaign.

- Created and led the development of a high-level quantum programming language, *quAPL*
- Performed research on quantum abstract machines above the circuit level
- Performed research on digital twins of superconducting quantum platforms
- Contributed to discussions across the quantum ecosystem on new programming models for quantum
- Served as committee member for the IQUIST Seminar series 2023-2024

Spring 2023 - present Quantum Lead Research Scientist, National Center for Supercomputing Applications, University of Illinois Urbana-Champaign.

- Developed the strategic plan for the organization on quantum computing

- Established an R&D agenda across the spectrum of quantum technologies funded at \$825,000 USD
- Managed campus access to IBM-Q leading to UIUC being the majority user in number of tasks
- Represented NCSA across multiple events on quantum technologies
- Established and managed relations with 20+ companies in the quantum space

Fall 2021 - present Faculty Affiliate, Center for Global Studies, University of Illinois Urbana-Champaign.

- Contributed to the Center's activities and administrative responsibilities
- Mentored graduate students in COVID-19 modeling for future coursework planning

Fall 2021 - Fall 2022 Adjunct Lecturer, School of Information Sciences, University of Illinois Urbana-Champaign.

- Taught *Analytic Foundations for Information Problems* to 60 students across two semesters with passing rate of 95%
- Contributed to curricular development adjacent to discrete mathematics

Spring 2021 - Spring 2023 Research Programmer, National Center for Supercomputing Applications, University of Illinois Urbana-Champaign.

- Established an original research program in agent-based modeling and complex systems science
- Architected and developed research software for the NSF-funded Molecule Maker Lab Institute
- Developed research software for the NIST-funded CoE post-disaster community resiliency (IN-CORE)

Spring 2021 Lecturer, Cenfotec University, Costa Rica.

- Taught *Fundamental mathematics* to 30 students across with passing rate of 90%
- Taught the *Introduction to Programming* to 35 students across with passing rate of 90%
- Contributed to curricular development adjacent to discrete mathematics

2012 - 2021 Board Member, Fundación Pro Energías Renovables, Costa Rica.

- Defined and oversaw the strategic direction and execution of scientific initiatives
- Co-organized events to promote green technologies attracting 10,000 participants
- Served as government representative

2019 - 2020 Outreach Liason, The Open Storage Network Project and National Center for Supercomputing Applications, University of Illinois Urbana-Champaign.

- Coordinated a project-wide cybersecurity evaluation by TrustedCI
- Discovered high-level functional specifications from use cases and technical teams
- Translated use case requirements to technical requirements

2018 Summer Research Intern, The Whole Tale Project and School of Information Sciences, University of Illinois Urbana-Champaign.

- Demonstrated the failure to reproduce the seminal MaxEnt paper in ecological niche modeling
- Designed of a Python software library for MaxEnt modeling using introspection

2016 - 2020 Graduate Research Assistant, Illinois Informatics and National Center for Supercomputing Applications, University of Illinois Urbana-Champaign.

- Developed a COVID-19 agent-based model which informed decision making in Champaign-Urbana
- Performed preliminary research on quantum computing applied to biomedicine for Mayo Clinic

- Performed high-impact research on statistical physics of complex systems

2011 - 2012 Coordinator, e-Science Research Program, Costa Rica Institute of Technology.

- Performed strategic program management and development
- Procured initial \$800k USD in funding for the e-Science laboratory
- Coordinated technical teams public university system on advanced research data networks research

2010 - 2011 Instructor, Department of Computer Science and Engineering, Costa Rica Institute of Technology.

- Taught Computer Architecture, Principles of Programming Languages and Operating Systems, Computing for Engineers, 160 students with passing rate of 87%
- Performed research on high performance computing, volcanic hazard modeling, quantum computing architectures, and computational physics

2006 - 2009 Junior Research Staff, Advanced Computing Collaborative and Nanotechnology Laboratory, National Center for Advanced Technology Studies of Costa Rica.

- Contributed to the deployment of the first national computing grid across the public university system
- Provided support to research scientists on scientific computing in computational volcanology, computational nanotechnology and remote sensor image processing
- Initiated and supported the process to reconnect the public university system to RedCLARA
- Organized and delivered computational science workshops to the academic community

PROFESSIONAL POSITIONS

2014 - 2015 Director General of Research and Technology Development, Ministry of Science, Technology and Telecommunications, Republic of Costa Rica.

- Edited and produced the National Plan of Science, Technology and Innovation 2015-2021 (2000 contributors, 52 writers, 5 topical areas)
- Founded the Directorate of Research and Technology Development to address OECD accession needs
- Served as research policy liaison at the Committee on Science and Technology Policy, OECD
- Developed new public policy instruments to direct government investment of \$65M USD annually

2011 - 2013 Director General of Digital Technology, Ministry of Science and Technology and Telecommunications, Republic of Costa Rica.

- Established officially and directed the governmental Cybersecurity Incident Response Team
- Co-coordinated a technical missions with South Korea on Cybersecurity (\$300K USD)
- Coordinated the governmental adoption of the Budapest Convention on Cybersecurity
- Cooperated with the Information and Communication Technology sector to map common needs
- Supervised the execution of 257 Intelligent Community Centers across Costa Rica
- Provided Strategic IT and cybersecurity advise across the public sector
- Served as the joint governmental representative of Costa Rica at ICANN and the Information Society

2009 - 2010 Senior Embedded Systems Engineer, RidgeRun LLC, Costa Rica.

- Implemented Android applications for audio and video control
- Implemented the 7002 TVP digital video driver in the Linux kernel
- Performed systems programming in C and ARM assembly language

AWARDS AND HONORS

- 2020** Young Scholar, Heidelberg Laureate Forum 2020, Klaus Tschira Stiftung, Heidelberg, Germany.
- 2020** Emerging Scholar, Technology, Knowledge and Society 2020 Conference, Urbana IL, USA.
- 2018** Scholar, Clinton Global Initiative University, Clinton Foundation.

GRANTS

- 2024** PI (\$ 200,000 USD, submitted). *CC* Integration-Small: Quantum-Resistant Cryptography in Supercomputing Scientific Applications*. (Phuong Cao, PI, NCSA UIUC) National Science Foundation.
- 2024** PI (\$ 125,000 USD, submitted). *User-Centered Integrated Quantum Development Environment for Algorithms Discovery and Workforce Development*. Discovery Partners Institute.
- 2024** Co-PI (\$ 125,000 USD, submitted). *Pricing and Scheduling Models for Quantum Resources*. (Abhijeet Ghoshal, PI, Gies College of Business UIUC) Discovery Partners Institute.
- 2023** Co-Principal Investigator (\$300,000 USD). *Quantum State Passing Interfaces for Distributed Quantum Computing*. (Bruno Abreu, PI, NCSA) Hybrid Quantum Architectures and Networks, NSF Quantum Leap Challenge Institute.
- 2023** Principal Investigator (\$225,000 USD). *Characterization and Tuning Strategies of Quantum Devices via Digital Twinning*. IBM-Illinois Discovery Accelerator Institute.
- 2022** Co-Principal Investigator (\$77,000 USD). Illinois Lyme Association, TREE program. *Community-Engaged Passive Tick Surveillance for Illinois*. UIUC.
- 2022** Grant recipient, Phases 1 and 2 (\$2,000 USD, quantum CPU hours), Illinois Quantum Applications Grant Program, Illinois Quantum Information Science and Technology Center, UIUC.
- 2022** NCSA Co-Principal Investigator. NCSA Fellows Program (Holly Tutton, Christopher Stone). BiteMap: Tracking Invasive Mosquitoes, Ticks, and Emerging Pathogens Through A Community-Engaged Web Registry. National Center for Supercomputing Applications, UIUC.
- 2021** Principal Investigator. XSEDE allocation (20,000 CPU hours). Scalable computational exploration of a stochastic agent-based model for COVID-19 spread and multifactor containment in the background of state re-opening. National Center for Supercomputing Applications, UIUC.
- 2019** Global Intersections Grant (\$3,000.00 USD), Center for Global Studies, University of Illinois at Urbana-Champaign.

FELLOWSHIPS

- 2018** Fellow (\$5,000.00 USD), Student and Early Career Fellowship, Whole-Tale/RDA-US.
- 2017** Fellow (\$45,000.00 USD), ACM SIGHPC/Intel Computational and Data Science Fellowship.
- 2007** Visiting fellow (\$5,000.00 USD), International Fellows Program, National Center for Supercomputing Applications, University of Illinois Urbana Champaign, Urbana IL, USA.
- 2005** Student scholar (\$3,000.00 USD), Global Grid Forum 15, Boston MA, USA.

TEACHING EXPERIENCE

University of Illinois Urbana-Champaign :

Spring 2023 Center for Global Studies. GLBL 499: Introduction to Computer Simulation of Global Risks. *Curricular design only.*

Spring 2022 School of Information Sciences. IS 203: Analytical Foundations for Information Problems.

Fall 2021 School of Information Sciences. IS 203: Analytical Foundations for Information Problems.

Cenfotec University :

Fall 2021 School of Software Engineering. INF-02: Foundations of Computer Programming.

Spring 2021 School of Software Engineering. MAT-00: Fundamental Mathematics.

Costa Rica Institute of Technology :

Spring 2011 Department of Computer Science and Engineering. CA-2025: Computing Fundamentals for Engineering.

Spring 2011 Department of Computer Science and Engineering. IC-3101: Computer Architecture.

Fall 2010 Department of Computer Science and Engineering. IC-6600: Operating Systems Principles.

Fall 2010 Department of Computer Science and Engineering. IC-4700: Programming Language Foundations and Pragmatics.

Fall 2010 Department of Computer Science and Engineering. IC-3101: Computer Architecture.

Spring 2010 Department of Computer Science and Engineering. IC-3101: Computer Architecture.

ACADEMIC ADVISING

Doctorate

Rebecca Vanderwalle – 2025 *CyberGIS-ABM Framework: Scalable Spatially Explicit Agent-Based Modeling for Emergency Evacuation.* (Preliminary examination, May 9, 2024) Advisor: Shaowen Wang, Department of Geography and Geographic Information Science, UIUC.

Master's

Francini Corrales-Garro – 2026 *High-level programming constructs and compilation.* School of Intelligent Systems, Cenfotec University (Costa Rica).

William Aguilar-Calvo – 2026 *New Strategies for Quantum Error Correction in Near-Term Devices.* School of Intelligent Systems, Cenfotec University (Costa Rica).

Diego Solís-Peñaranda – 2026 *Thermodynamics of Information Processing in Quantum Cellular Automata.* Department of Computer Engineering, Costa Rica Institute of Technology (Costa Rica).

Luis Carlos Lara-López – 2024 *On the Feature Space and Architecture of ABM Frameworks.* Department of Computer Engineering, Costa Rica Institute of Technology (Costa Rica). *Summa Cum Laude.*

MENTORSHIP

Graduate :

Fall 2023 – Fall 2024 Oliver Wolff (Physics, UIUC). *Characterization and Tuning Strategies of Quantum Devices via Digital Twinning.* IBM-Illinois Discovery Accelerator Institute, IBM-UIUC. PI (Advisor: Wolfgang Pfaff).

Fall 2023 Samihr Hermes (Physics, UIUC). *Characterization and Tuning Strategies of Quantum Devices via Digital Twinning.* IBM-Illinois. PI (Advisor: Eric Chitambar).

Spring 2023 Sharon Lam (MS CS, UIUC). *Interactive Visualization of Ensemble Data for Computational Epidemiology*. NCSA, UIUC. Primary mentor.

Fall 2022 Seungmi Kim (Ph.D. Political Science, UIUC). *Pedagogical uses of COVID-19 agent-based modeling a Global Security course (NPPE 580)*. NCSA, UIUC. Domain-area mentor (PI: Matthias Perdekamp, Physics/NPRE).

Summer 2022 - Spring 2023 Cindy Wong (Materials Science, UIUC). *First-principles and machine learning modeling of atomic disorder and optical properties*. NCSA Faculty Fellows Program 2022-2023 (PI: André Schleife). NCSA, UIUC. NCSA mentor.

Undergraduate :

Fall 2024 - present Shaan Doshi (CS, UIUC). *Quantum State Passing Interface*. NCSA SPIN Program. NCSA, UIUC. Primary mentor.

Summer 2024 Brandon Taylor (Medicine, UIUC). *Programming for Clinical Learning*. NCSA-ICM academic experience program. NCSA, UIUC. Co-mentor.

Summer 2023 - Summer 2024 Bach Hoang (Mathematics, UIUC). *Verifiable quAPL*. NCSA SPIN Program. NCSA, UIUC. Primary mentor.

Summer 2022 - Spring 2023 Boda Song (Statistics/CS, UIUC). *COVID19-Mesa: integrating database access to a COVID-19 ABM simulation platform toward experimental scalability*. Recipient of the Fiddler Innovation Undergraduate Student Fellowship Award 2022. NCSA SPIN Program. NCSA, UIUC. Primary mentor.

Summer 2022 - Spring 2023 Xinyi Huang (Statistics, UIUC). *COVID19-Mesa: using CERN ROOT for high-performance scientific visualization*. Recipient of the Fiddler Innovation Undergraduate Student Fellowship Award 2022. NCSA SPIN Program. NCSA, UIUC. Primary mentor.

Summer 2022 - Spring 2023 Jeff Zhou (Engineering Physics/Applied Physics, Cornell). *Understanding prediction accuracy of ML methods for temperature-dependent dielectric functions in diamond*. NCSA REU Program. NCSA, UIUC. Co-mentor.

Summer 2021 - Spring 2022 Angelo Santos (Electrical and Computer Engineering, UIUC). *Application of an agent-based model simulation platform to evaluate COVID-19 control measures in northern Illinois counties*. NCSA SPIN Program. NCSA, UIUC. Co-mentor.

PUBLICATIONS

■ Journal Articles

1. Núñez-Corrales, S. and Brenes-André, J. (2023). BALISTICA: a software suite for ballistic motion with applications to geophysics research and education. *Software Impacts*.
2. Segura-Ulate, I., Bolívar-González, A., Madrigal-Redondo, G., Núñez-Corrales, S., & Gatica-Arias, A. (2022). Reverse-Transcription Loop-Mediated Isothermal Amplification and alternative protocols for lower cost, large-scale COVID-19 testing: lessons from an emerging economy. *Revista de Biología Tropical*, 70(1), 173-189.
3. Núñez-Corrales, S., and Jakobsson, E. (2021). Entropic boundary conditions towards safe artificial superintelligence. *Journal of Experimental & Theoretical Artificial Intelligence*, 1-33.
4. Castillo, G. B., Núñez-Corrales, S., & Malavassi, E. (2018). Ash fallout hazard from Irazú volcano, Costa Rica. *Revista Geográfica de Chile Terra Australis*, 54(1), 13-25.
5. Porras-Gómez, M., Vega-Baudrit, J., & Núñez-Corrales, S. (2018) Ampicillin-Loaded Chitosan Nanoparticles for In Vitro Antimicrobial Screening on Escherichia coli. In *Chitin-Chitosan-Myriad Functionalities in Science and Technology*. IntechOpen.

6. Katz, D. S., Niemeyer, K. E., Gesing, S., Hwang, L., Bangerth, W., Hettrick, S., Idaszak, R., Salac, J., Hong, N.C., & Núñez-Corrales, S., Allen, A. (2018). Fourth Workshop on Sustainable Software for Science: Practice and Experiences (WSSSPE4). *Journal of Open Research Software*, 6(1).
7. Porras-Gómez, M., Vega-Baudrit, J., García, F., Núñez-Corrales, S., & Madrigal-Carballo, S. (2017). Evaluation of the Synergistic Effect of EDTA-Functionalized Chitosan Nanoparticles on Imipenem Delivery in *Pseudomonas aeruginosa* Carbapenem-Resistant Strain AG1. *Journal of Biomaterials and Nanobiotechnology*, 9(01), 64.
8. Jakobsson, E., Argüello-Miranda, O., Chiu, S. W., Fazal, Z., Kruczek, J., Nunez-Corrales, S., Pandit, S. & Pritchett, L. (2017). Towards a Unified Understanding of Lithium Action in Basic Biology and its Significance for Applied Biology. *The Journal of Membrane Biology*, 250(6), 587-604.
9. Núñez-Corrales, S. (2016). A preliminary model for the impact of research and development in health care expenditure: the case of Costa Rica. *Revista Hispanoamericana de Ciencias de la Salud*, 2(1), 52-61.
10. Barrantes-Castillo, G., Nunez-Corrales, S., Mora, J. C., Malavassi-Rojas, E. M., & Montoya, C. S. (2013). Irazu volcano ash fall simulation using a modification of the tephra software. *Geo Uerj*, 5-18.
11. Porras-Gómez, M., Vega-Baudrit, J., & Núñez-Corrales, S. (2012). Overview of multidrug-resistant *Pseudomonas aeruginosa* and novel therapeutic approaches. *Journal of Biomaterials and Nanobiotechnology*, 3(04), 519.
12. Barrantes-Castillo, G., Nunez-Corrales, S., Malavassi-Rojas, E. (2011). Computer Simulation as a Tool for Land and Risk Management: the Case of Ashfall from the Irazu Volcano, Costa Rica. *Revista Geográfica de América Central*, 2(48E) 197-212.
13. Vega-Baudrit, J., Sibaja-Ballesteros, M., Vázquez, P., Núñez-Corrales, S., Martín-Martínez, J. M., & Benavides-Rodríguez, L. (2008). Kinetics of isothermal degradation studies in adhesives by thermogravimetric data: effect of hydrophilic nanosilica fillers on the thermal properties of thermoplastic polyurethane-silica nanocomposites. *Recent Patents on Nanotechnology*, 2(3), 220-226.

■ Books

1. Núñez-Corrales, S. (2018). [Translated from Spanish title] Global opportunities toward high-value ventures in Costa Rica: Frontiers, Technologies, Referents and Strategies. Luis Alonso Jiménez-Silva (Ed.) *Joint official publication by the University of Costa Rica, the Ministry of Science, Technology and Telecommunications, and the National Council for Science and Technology Research*. URL: <https://www.kerwa.ucr.ac.cr/handle/10669/74612>

■ Editorial Work

1. Ministry of Science, Technology and Telecommunications (2015). [Translated from Spanish title] Science, Technology and Innovation National Plan 2015–2021. Núñez-Corrales, S., Loría-Herrera, P (Ed.) *Ministry of Science, Technology and Telecommunications, Republic of Costa Rica*. URL: <https://www.micit.go.cr/sites/default/files/pncti.pdf>

■ Book Chapters

1. Núñez-Corrales, S. (2021). Complexity: Some considerations towards a predictive theory of life. In: Gustavo Caetano-Anollés (Ed.) *Untangling Molecular Biodiversity: Explaining Unity and Diversity Principles of Organization with Molecular Structure and Evolutionary Genomics*. World Scientific, Singapore, pp. 453-489.

■ Conference Proceedings

1. Frenkel, M., Pfaff, W., Núñez-Corrales, S., Kooper, R. (2024). Lab Dragon: An Electronic Laboratory Notebook to Support Human Practices in Experimental Science. *2nd Annual Conference of the US Research Software Engineer Association (US-RSE'24)*, Albuquerque, NM, August 23.
2. Núñez-Corrales, S., Frenkel, M., & Abreu, B. (2023). quAPL: Modeling Quantum Computation in an Array Programming Language. *IEEE QCE 2023*. Bellevue, WA, September 16-22.
3. Parunak, H.V.D., Núñez-Corrales, S. (2022). Interactions, Model Mechanisms and Behavioral Attractors in Complex Social Systems. *2022 Conference of The Computational Social Science Society of the Americas. CSSSA 2022*. Santa Fe NM, October 27-30.
4. Núñez-Corrales, S., Venkatachalapathy, R., Graham, J., Mudigonda, S.P. (2022). Higher-order interactions in ABM: a case study using topologically-perturbed voter models. *2022 Conference of The Computational Social Science Society of the Americas. CSSSA 2022*. Santa Fe NM, October 27-30.
5. Mudigonda, S.P., Núñez-Corrales, S., Venkatachalapathy, R., Graham, J. (2022). Scheduler Dependencies in Agent-Based Models: A Case-Study Using a Contagion Model. In: Yang, Z., von Briesen, E. (eds) *Proceedings of the 2021 Conference of The Computational Social Science Society of the Americas. CSSSA 2021*. Springer Proceedings in Complexity. Springer, Cham.
6. Núñez-Corrales, S., Friesen, M., Mudigonda, S., Venkatachalapathy, R., & Graham, J. (2021) In-Silico Models With Greater Fidelity to Social Processes: Towards ABM Platforms With Realistic Concurrency. In: Yang Z., von Briesen E. (eds) *Proceedings of the 2020 Conference of The Computational Social Science Society of the Americas*. Springer Proceedings in Complexity. Springer, Cham.
7. Salamanca J., and Núñez-Corrales S. (2021) Social Viscosity, Fluidity, and Turbulence in Collective Perceptions of Color: An Agent-Based Model of Color Scale Convergence. In: Yang Z., von Briesen E. (eds) *Proceedings of the 2019 International Conference of The Computational Social Science Society of the Americas*. CSSSA 2020. Springer Proceedings in Complexity. Springer, Cham.
8. Núñez-Corrales, S., and Jakobsson, E. (2011). Hierarchical Modularity: The Description of Multi-Level Complex Systems as Nested Coupled Fokker-Planck Equations. In: Minai, A, Sayama, H, Braha D, D, & Bar-Yam, Y (Eds.) *Unifying Themes in Complex Systems Volume VIII: Proceedings of the Eighth International Conference on Complex Systems*. NECSI Knowledge Press, United States of America, pp. 967-981.

■ Conference Papers

1. Di Matteo, O., Núñez-Corrales, S., Stechly, M., Reinhardt, S., Mattson, T. (2024). An Abstraction Hierarchy Toward Productive Quantum Programming. *IEEE QCE 2024*. Montreal, Quebec, Canada. September 18.
2. Núñez-Corrales, S., Li, L., & Ludäscher, B. (2020). A first-principles algebraic approach to data transformations in data cleaning: understanding provenance from the ground up. *USENIX TaPP*.
3. McPhillips, T.-M., Willis, C., Gryk, M.-R., Núñez-Corrales, S., & Ludäscher, B (2019). Reproducibility by Other Means: Transparent Research Objects. *RO2019 Workshop at IEEE eScience Conference 2019*. San Diego, CA USA. September 24-27, 2019.
4. Núñez-Corrales, S., and Gasser, L. (2018, accepted) Scalable social simulation: an evaluation of modeling frameworks as cyberinfrastructures and the design-test of a new approach. *SPR-BRiMS 2018*. George Washington University, Washington DC, USA, July.
5. Núñez-Corrales, S., and Gasser, L. (2016) Simulation-Oriented Cyberinfrastructure for Computational Social Science. *The Computational Social Science (CSS 2016) Annual Conference*. Santa Fe NM, Oct 24 – 27.

6. Núñez-Corrales, S., Bethwaite, B., Brenes, J., Barrantes, G., Castro, J., Malavassi, E., & Abramson, D. (2010). NG-TEPHRA: A massively parallel, nimrod/g-enabled volcanic simulation in the grid and the cloud. *2010 IEEE Sixth International Conference on e-Science*. IEEE. Brisbane, Australia, December 7-10.
7. Núñez-Corrales, S., Barrantes, G., Malavassi, E., Brenes, J., & Castro, J. (2010). On the Structure of Parametric Sweeps in Large-Scale, Grid-Enabled Ash Deposition Simulations for the Irazu Volcano in the PRAGMA Grid. *2010 Fifth International Conference on Frontier of Computer Science and Technology*. IEEE. Changchun, Jilin Province, China, August 21-25.
8. Núñez-Corrales, S., Vega J., & de la Ossa, A. (2007). Simulation and Optimization of Carbon Nanotubes Growth Processes. *XXXIII Latin American Conference on Informatics (CLEI)*. San José, Costa Rica, October 9-12.
9. Barrantes, G., Garita, C., Núñez-Corrales, S., & Castro, J. (2007). Application of Geographic Information Systems in the Creation of Risk Scenarios for Tephra Fall. *XXXIII Latin American Conference on Informatics (CLEI)*. San José, Costa Rica, October 9-12.
10. Núñez-Corrales, S. (2007). The Costa Rican Software Industry: The Research + Development + Innovation challenge: How is success fostered in innovation initiatives? *XXXIII Latin American Conference on Informatics (CLEI)*. San José, Costa Rica, October 9-12.
11. Torres F., Fallas A., & Núñez-Corrales, S. (2007). Is Action Research the Path to a Solid Research Culture in IS/SE for Costa Rica? *XXXIII Latin American Conference on Informatics (CLEI)*. San José, Costa Rica, October 9-12.

■ Conference Workshops

1. Giusto, E., Rieffel, E., Núñez-Corrales, S., Cao, P. (2024) First Workshop on Dependability Challenges in Hybrid Classical-Quantum Computing Systems (DCHCQCS). *Workshop on Pulse-Level Languages, Interfaces and Intermediate Representations at IEEE International Conference on Quantum Computing and Engineering 2024*. Montreal, Quebec, Canada. September 20.
2. Giusto, E., Núñez-Corrales, S., Cao, P. (2024) Half-day Virtual Workshop on Dependable Classical-Quantum Computing Systems Engineering (DCQCS). *National Center for Supercomputing Applications, UIUC*. Online, April 17.
3. Mattson, T., Didri, R., Gokhale, P., Isreali, D., Lubisnki, T., Núñez-Corrales, S., Reinhardt, S., Sanders, Y. R., Stechly, M. & Stollenwerk, T. (2023). Quantum Computing Market Success Requires an Application-level Programming Model that Delivers Performance. *IEEE QCE 2023*. Bellevue, WA, September 16-22.

■ Conference Panels

1. Núñez-Corrales, S., Friel, J., Izaac, J., Barnes, K., Heim, B. (2024) Hybrid Systems and Error Correction. *Workshop on Pulse-Level Languages, Interfaces and Intermediate Representations at IEEE International Conference on Quantum Computing and Engineering 2024*. Montreal, Quebec, Canada. September 16.
2. Weingard, D., Lennon, D., Dalvi, A., Alexander, T., Kirste, M., Roy, A., Núñez-Corrales, S., Friel, J., Battistel, F. (2024) Challenges and roadmap for pulse-level languages, interfaces and intermediate representations. *Workshop on Pulse-Level Languages, Interfaces and Intermediate Representations at IEEE International Conference on Quantum Computing and Engineering 2024*. Montreal, Quebec, Canada. September 15.
3. Sorensen, B., Cohen, Y., Pütz, M., Núñez-Corrales, S., Palles-Dimmock, J., Michielsen, C., Varetto, U. (2023). A Component-Based Approach for Integrating Quantum Computing Test Beds into HPC Environments: Challenges and Opportunities. *The International Conference for High Performance Computing, Networking, Storage, and Analysis. SC 24*. Denver CO, November 12-17.

■ Position Papers

1. Núñez-Corrales, S. (2023). Quantum abstract machines without circuits: the need for higher algorithmic expressiveness. *ASCR Basic Research Needs in Quantum Computing and Networking*. U.S. Department of Energy, Office of Advanced Scientific Computing Research.
2. Abreu, B., Núñez-Corrales, S. (2023). Quantum State Passing Interfaces for Distributed Quantum Computing. *ASCR Basic Research Needs in Quantum Computing and Networking*. U.S. Department of Energy, Office of Advanced Scientific Computing Research.
3. Chia, N., Agarwal, N., Núñez-Corrales, S. (2023). Causality Discovery in Biomedicine as a Killer Application for Quantum Computing *ASCR Basic Research Needs in Quantum Computing and Networking*. U.S. Department of Energy, Office of Advanced Scientific Computing Research.
4. Didri, R., Gokhale P., Israeli, D., Mattson, T., Lubinski, T., Núñez-Corrales, S., Reinhardt, S., Sanders, Y., Stechly, M., & Sotllenwerk, T (2023). Quantum Computing Requires Application-level Programming Models that Deliver Performance. *ASCR Basic Research Needs in Quantum Computing and Networking*. U.S. Department of Energy, Office of Advanced Scientific Computing Research.
5. Franklin, K. Burton, O., Appleford, S., Yahja, A., & Núñez-Corrales, S. (2008). TeraGrid II: a vision toward the 21st century integrated knowledge infrastructure. *The Future of the TeraGrid, Position Papers*.

■ Conference Presentations

1. Núñez-Corrales, S., Cao, P., Hoang, B. (2024). The Landscape of Formal Verification in APL: a Review with a Case Study in Quantum Computing *ARRAY 24 in PLDI 24*. Copenhagen, June 24–28.
2. Lee, J., Navarro, C., Núñez-Corrales, S., Naum, K., Wang, C., Kim, Y.-W., Kooper, R., van de Lindt, J., and Brown Kruse, J. (2022, accepted). IN-CORE - Computational Platform for Community Resilience Planning. *AGU Fall Meeting 2022*. Chicago IL, December 12–16.
3. Núñez-Corrales, S. (2022). Recovery of resonant stochastic fluctuations in an interacting-particle system-based contagion model coupled with social mimicry: comparative analysis of the effect of event ordering in their corresponding agent based models. *Bulletin of the American Physical Society*.
4. Núñez-Corrales, S., (2022). Renormalization group theory and scheduler dependencies in Agent-Based Models: two modeling aspects toward higher model fidelity. *XXIII International Symposium on Mathematical Methods Applied to the Sciences (XXIII SIMMAC)*. San José, Costa Rica. February 21–25.
5. Núñez-Corrales, S., and Jakobsson, E. (2020). A generalized theory of interactions for complex multiscale stochastic systems with thermodynamic irreversibility. *Bulletin of the American Physical Society*.
6. Núñez-Corrales, S., Jakobsson, E. (2016). Some requirements of formal languages for the scientific description of nature. *IV Latin American Congress on Analytic Philosophy*. San José, Costa Rica. May 25–27.
7. Núñez-Corrales, S., Barrantes G., Malavassi E., Brenes J. (2010). NG-TEPHRA: Enabling Large-Scale Volcanic Hazard Simulations in the Pragma Grid Environment. *PRAGMA Workshop 18*. San Diego, California, March 3–5.
8. Argüello, O., Villatoro, F., Núñez-Corrales, S. (2008). An epidemiological model of dengue fever including second infection stage in human hosts. *XVI International Symposium on Mathematical Methods Applied to the Sciences (XVI SIMMAC)*. San José, Costa Rica. Feb 19–22.

■ Preprints

1. Giusto, E., Núñez-Corrales, S., Cao, P., Cilardo, A., Iyer, R. K., Jiang, W., Rech, P., Vella, F., Montruocchio, B., Dasgupta, S., Humble, T. (2024). Dependable Classical-Quantum Computer Systems Engineering. *arXiv*.
2. Núñez-Corrales, S. (2023). Quantum abstract machines without circuits: the need for higher algorithmic expressiveness. *arXiv*.
3. Solís, M., Pasquier, C., Núñez-Corrales, S., Madrigal-Redondo, G., and Gatica-Arias, A. (2022). Estimating the performance of mass testing strategies for COVID-19: a case study for Costa Rica. *medRxiv*.
4. Núñez-Corrales, S., and de Camino-Beck, T. (2020). [*Translated from Spanish title*] Estimation of the effectiveness of non-pharmacological measures on hospitalization as a control measure for SARS-CoV-2 in Costa Rica. *ResearchGate*. URL: <https://bit.ly/3HBBUFE>.
5. Núñez-Corrales, S., and Jakobsson, E. (2020). The Epidemiology Workbench: a Tool for Communities to Strategize in Response to COVID-19 and other Infectious Diseases. *medRxiv*.

■ Scientific Reports

1. Alvarado, G.E., Brenes-André, J., Núñez, D., Borbón, J., Ramírez, J. A., Alpízar, Y., Núñez-Corrales, S., Sibaja, J.P., and Esquivel, L. (2023) Updated analysis of volcanic hazard for Arenal Volcano, Costa Rica. *Costa Rica Institute of Electricity and National Emergency Commission*.
2. Alvarado, G.E., Brenes-André, J., Venegas, L., Alpízar, Y., Núñez-Corrales, S., Sánchez, M., Abarca, K., Abarca, J., Báez, W.A., Sibaja, J.P., Esquivel, L., and Arcia, T. (2022) Analysis of volcanic hazard for Rincón de la Vieja Volcano, Costa Rica. *Costa Rica Institute of Electricity and National Emergency Commission*.
3. Alvarado, G.E., Campos-Durán, D., Brenes-André, Sibaja, J.P., Fallas, B., Esquivel, L., Núñez-Corrales, S. (2021) Analysis of volcanic hazard for Irazú Volcano, Costa Rica. *Costa Rica Institute of Electricity and National Emergency Commission*.
4. Núñez-Corrales, S., and Ludäscher, B. (2019) HoH-Companion: Preserving Hierarchies of Hypotheses for Scientific Experiments in the Whole Tale. *A report to the RDA/US-Whole Tale Data Share and Early Career Fellows program*.

■ Poster Presentations

1. Hoang, B., Cao, P., Abreu, B. & Núñez-Corrales, S., (2022, submitted). The International Conference for High Performance Computing, Networking, Storage, and Analysis *Association for Computing Machinery*. Denver CO, Nov 12-17.
2. Núñez-Corrales, S. & Jakobsson, E., (2022). Unveiling classes of self-organization across complex multiscale stochastic systems through a generalized theory of interactions. *Bulletin of the American Physical Society*.
3. Núñez-Corrales, S., Ludäscher, B. (2018), Franz, N. Reproducibility in Ecological Niche Models: the case of Phillips et al (2006). *Whole Tale Workshop on Tools and Approaches for Publishing Reproducible Research*. Chicago, IL. September 12-14.
4. Jakobsson, E., Kindratenko, V., Lipka, A., Núñez-Corrales, S. (2018) Accelerating multiple hypothesis testing through GPU/FPGA hardware accelerators and quantum computing infrastructure: Application to genome-wide association studies. *CCBGM Biannual Meeting*. Mayo Civic Center, Rochester MN.
5. Núñez-Corrales, S., Caesar J., MacCalla T. (2015). ICIMSware 2.0: Community Informatics for Collaborative Competitiveness. *Collective Intelligence 2015*. Santa Clara CA, USA. May 31-June 2.

6. Caesar J., MacCalla T., Núñez-Corrales, S., Wang S., Castro-Mora J. (2009). i-CIMSware: Community Profiling and Asset Mapping Understanding Regional Development through Algorithms and Computation. *TeraGrid 09*. Arlington, VA, USA. June 22-25.
7. Núñez-Corrales, S., Rivera, A. (2010). Simulation of the Synthesis of SWCNTs using Computational Quantum Chemistry. *XII Latin American Symposium on Polymer Science*. San José, Costa Rica. July 13-16.

ADDITIONAL TRAINING

- 2019 Summer School** Illinois Quantum Computing Summer School, Discovery Partners Institute, Chicago IL.
- 2015 Specialized Course** ISOC Policy Fellows IETF training, Internet Engineering Task Force and Information Society, Prague Czech Republic.
- 2015 Specialized Course** Internet Community 15 - Event Design and Internet Infrastructure Leadership, Information Society, Buenos Aires Argentina.
- 2011 Specialized Course** Cybersecurity Incident Handling, Carnegie Mellon University and Organization of American States, Washington DC.
- 2008 SC Education Workshop** Nanotechnology and High Performance Computing in Education and Research, SC Education Workshop, Limón Costa Rica.
- 2008 Specialized Course** Nanoscience and Nanotechnology, National Center for Advanced Technology Studies, San José Costa Rica.
- 2008 Specialized Course** Recent Advanced in Thermal Analysis, National Center for Advanced Technology Studies, San José Costa Rica.
- 2008 Specialized Course** Physical Chemistry of Surfaces, National Center for Advanced Technology Studies, San José Costa Rica.

EDITORIAL WORK

Calls for Proposals :

2022, 4th EU-LAC Joint Call in STI Expert reviewer. European Union-Latin America and Caribbean Platform on Research and Innovation.

Journals :

2023 – present, Journal of Open Source Software Reviewer.

2022 – present, Frontiers in Physics Topic Editor for Research Topics issue: *Potential Contributions of Quantum Algorithms for the Biosciences: The Prospect of Current Noisy Intermediate-Scale and Fully Tolerant Quantum Devices*.

Proceedings :

Computational Social Science, 2023 Editor: *Proceedings of the 2022 Conference of The Computational Social Science Society of the Americas*. Springer.

Conferences :

CONCAPAN 2024 Reviewer.

CSS 2024 Reviewer.

Gateways 2024 Reviewer.

CSS 2023 Program Committee member and Reviewer.

US-RSE 2023 Reviewer.

Gateways 2023 Reviewer.

CSS 2022 Program Committee member and Reviewer.

INVITED TALKS

- November 3, 2024 - Talk** A Prescriptive Definition of Resiliency for Dependable Classical-Quantum Computer Systems Engineering. *StableQ 2024: Quantum System Stability and Reproducibility Workshop. IEEE MICRO 2024*. Austin TX.
- September 15, 2024 - Talk** A prescriptive view into the future of quantum software stacks. *Workshop on Pulse-Level Languages, Interfaces and Intermediate Representations. IEEE International Conference on Quantum Computing and Engineering 2024*. Montreal, Quebec, Canada.
- September 6, 2024 - Talk** *Quantum computing, ML and automation: a review of opportunities for molecular discovery* Air Force Research Laboratory, Wright-Patterson Air Force Base, Dayton OH.
- January 17, 2023 - Keynote** *Quantum Computing: Prospects for Agribusiness in the Digital Age* The VISION Conference. Glendale AZ.
- March 24, 2021 - Keynote** *Multi-agent simulation and data analysis in the COVID-19 era: two strategies for studies and control in epidemiology*. National Academy of Sciences, Costa Rica.
- March 10, 2021 - Talk** *Toward a Generalized Theory of Interactions: the role of homological algebra*. School of Mathematics, National University of Costa Rica.
- January 26, 2021 - Talk** *Unveiling the effect of non-pharmaceutical COVID-19 interventions in Costa Rica: hospitalizations and their velocities as robust proxies of the contagion process*. With Tomás de Camino-Beck. Covid Community Action Summit (C-CAS), New England Complex Systems Institute (NECSI).
- August 26, 2020 - Talk** *Stochastic multi-agent simulation for COVID-19 mitigation in Urbana-Champaign, IL: models in the context of decision making under critical circumstances*. School of Mathematics, National University of Costa Rica.
- May 11, 2020 - Talk** *A multi-agent model for COVID-19 spread in San José, Costa Rica*. State of the Nation Program, National Council of University Presidents, Costa Rica.
- March 20, 2015 - Keynote** *Costa Rica towards 2050: rethinking world development through evidence-based, data driven decision-making*. International Symposium on Grids and Clouds 2015, Academia Sinica, Taipei, Taiwan.
- July 15, 2013 - Keynote** *Science and Technology, the 21st Century and the Americas: Towards Regional Multidisciplinary Envisioning*. PASI 2013: Methods in Computation Based-Discovery, Guatemala City, Guatemala.

SERVICE

- 2023-present** IBM-Q campus access administrator, National Center for Supercomputing Applications/Illinois Quantum Science and Technology Center University of Illinois Urbana-Champaign and Chicago Quantum Exchange, USA.
- 2022-present** Hiring committee member, National Center for Supercomputing Applications, University of Illinois Urbana-Champaign, USA.
- 2022-present** At-Large Board Member, Computational Social Science Society of the Americas, USA.
- 2021-2022** Member, Software Working Group, National Center for Supercomputing Applications, University of Illinois Urbana-Champaign, Urbana IL, USA.
- 2018-present** Member, Conceptual Foundations Group, School of Information Sciences, University of Illinois at Urbana Champaign, Urbana IL, USA.

- 2017** Development of next-generation high-technology innovation and entrepreneurship prospection and fund allocation strategy, University of Costa Rica, Ministry of Science, Technology and Telecommunications, and National Council for Science and Technology Research, Costa Rica.
- 2015** Member, Advisory committee for Inclusive Growth, Committee on Science and Technology Policy, Organization for Economic Development and Cooperation, Paris (France).
- 2015** Editor of the National Science, Technology and Innovation Plan 2015-2021, Ministry of Science, Technology and Telecommunications, Costa Rica.
- 2015** Expert Jury for the National Prize on Information and Communications Technology. Chamber of Information and Telecommunication Technologies, Costa Rica.
- 2013-2018** *Ad honorem* board member of the Foundation for Renewable Energy, Costa Rica.
- 2013-2015** Country liaison, Committee on Science and Technology Policy, Organization for Economic Development and Cooperation, Paris, France.
- 2013-2015** President of the Expert Jury for the National Prize in Technology Awarding Committee. Ministry of Science, Technology and Telecommunications, Costa Rica.
- 2012-2015** Steering committee member, Advanced Research and Technology Collaborative for the Americas at the Organization of American States, Washington D.C., USA.
- 2013** Expert Jury for the National Prize on Information and Communications Technology. Chamber of Information and Telecommunication Technologies, Costa Rica.
- 2008** Local coordinator, SC08 Education Program Workshop on Nanotechnologies and High Performance Computing in Education and Research. EARTH, Limón, Costa Rica. June 29-July 5. First SC Education Workshop to be executed outside the US.
- 2002-2015** *Ad honorem* music instructor, performer and substitute band conductor, Vásquez de Coronado Music School, San José, Costa Rica.