

Walter O. Krawec

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(Updated August 2022)

Education:

Ph.D. Computer Science

Stevens Institute of Technology, Hoboken NJ

Dissertation: *Semi-Quantum Key Distribution: Protocols, Security Analysis, and New Models*

Graduated May 2015

MA Mathematics

University at Albany (SUNY), Albany NY

Graduated May 2010

BA Mathematics

Mount Saint Mary College, Newburgh NY

Graduated May 2008

Professional Experience:

Assistant Professor of Computer Science & Engineering University of Connecticut , Storrs CT	2017-Present
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Assistant Professor of Computer Science Iona College , New Rochelle NY	2015-2017
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Research Assistant Stevens Institute of Technology , Hoboken NJ	2011-2015
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Instructor University at Albany (SUNY) , Albany NY	2010-2011
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Teaching Assistant University at Albany (SUNY) , Albany NY	2010-2011
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Funding:

External:

- **NSF: CAREER: Hybrid Approaches to Quantum Cryptography: New Methods and Protocols**
Principle Investigator, \$497,433 (3/15/22 to 2/28/27)
- **Comcast: Advanced Modular Quantum Key Distribution Software Stack**
Principle Investigator, \$15,000 (5/23/2021 to 5/22/2022)
- **NSF: FET: Small: Theoretical Foundations and Applications of High Dimensional Quantum Communication**
Principle Investigator, \$317,846 (9/30/20 to 9/29/23)
- **NSF: CIF: Small: Secure Quantum Communication with Limited Resources**
Principle Investigator, \$309,582 (10/1/18 to 9/30/22)
- **Comcast: Development of Experimental Test-Bed for Multi-User Quantum Communication Protocols**
Principle Investigator, \$225,125 (4/1/2019 to 2/29/2020)
- **Comcast: Survey of Practical Quantum Key Distribution Systems**
Principle Investigator, \$27,129 (8/1/18 to 12/31/20)

Internal:

- **University of Connecticut (REP): Analyzing the Security of Quantum Cryptographic Protocols through Classical-Quantum Sampling**
Principle Investigator, \$18,069 (9/1/2019 to 6/1/2020)
- **University of Connecticut: UConn Scholarship Facilitation Fund (SFF)**
Principle Investigator, \$1120.12 (08/18 to 09/18)

Teaching Experience:

University of Connecticut, Storrs CT

2017-Present

- Introduction to Computing for Engineers (Sp 20, Sp 21, Sp 22)
 - Redesigned course in a “flipped” format
- Introduction to Computer and Network Security (Sp 2019, Fall 21)
- Cryptography (Fall 2017, Fall 2018, Fall 2019)
- Introduction to Quantum Computing (Sp 18, Fall 20)
- Quantum Computing, Cryptography, and Networking (Sp 22)

Iona College , New Rochelle NY	2015-2017
<ul style="list-style-type: none"> • Cryptography (Spring 2016, Spring 2017) • Computer Networking and Network Programming (Spring 2016, Spring 2017) • Introduction to Robotics (Fall 2017) • Network Security (Fall 2016) • Automata and Formal Languages (Fall 2016) • Computer Science II (Spring 2016, Fall 2016) • Data Structures and Algorithm Analysis (Fall 2015) • Programming Languages (Fall 2015) 	
University at Albany (SUNY) , Albany NY	2010-2011
<ul style="list-style-type: none"> • Algebra and Calculus I (Fall 2010) • Calculus I (Spring 2011) 	

Awards:

Robert Crooks Stanley Graduate Fellowship Stevens Institute of Technology	2014-2015
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Invited Talks:

A Modular QKD Software Stack <i>ATIS: Quantum-Safe Communication and Information Initiative (QSII)</i>	Sep. 22, 2021
Quantum Sampling and QKD Security Analysis <i>Quantum Reading Group, University of Massachusetts, Amherst</i>	May 27, 2021
Quantum Key Distribution with Limited Resources. <i>CICS Seminar. University of Massachusetts, Amherst</i>	Nov. 15, 2019
Quantum Computing – The Final Frontier? <i>CableLabs Summer Conference</i>	Aug. 5, 2019
Quantum Key Distribution. <i>Comcast Quantum Computing Working Group</i>	June 8, 2018
Quantum Computing. <i>University of Connecticut EE-CS Graduate Seminar</i>	Feb. 16, 2018
Semi-Quantum Key Distribution. <i>University of Connecticut ECE/CSE Security Seminar</i>	Oct. 24, 2017
Security of a Semi-Quantum Key Distribution Protocol. <i>Security and Quantum Information Group (SQIG) in Instituto de Telecomunicacoes (IT) in Lisbon</i>	Sep. 25, 2017

Publications:

(* Represents a student coauthor.)

Peer-Reviewed Journal and Conference Papers:

1. W. O. Krawec (2022). Security of a high dimensional two-way quantum key distribution protocol. To appear: *Advanced Quantum Technologies*. Pre-print available online: arXiv:2203.02989
2. S. Mutreja & W. O. Krawec (2022). Improved Semi-Quantum Key Distribution with Two Almost-Classical Users. To appear: *Quantum Information Processing*. Pre-print available online: arXiv:2203.10567
3. K. Yao*, W. O. Krawec, & J. Zhu (2022). Quantum sampling for finite key rates in high dimensional quantum cryptography. *IEEE Transactions on Information Theory*, 68 (5), pp. 3144-3163. Pre-print available online: arXiv:2012.04151
4. O. Amer* & W. O. Krawec (2022) High-Dimensional Quantum Conference Key Agreement. To appear: *Proc. IEEE International Symposium on Information Theory (ISIT)*. Pre-print available online: arXiv:2202.00140
5. W. O. Krawec (2022). Quantum random number generation with practical device imperfections. *Proc. Quantum Information Science, Sensing, and Computation XIV* vol. 12093 pp. 44-52.
6. J. Guskind* & W. O. Krawec (2022). Mediated semi-quantum key distribution with improved efficiency. *Quantum Science and Technology*, 7(3) 035019. Pre-print available online: arXiv:2111.01627
7. Z. Tang, P. Zhang, W. O. Krawec, & L. Wang (2022). Quantum Networks for Resilient Power Grids: Theory and Simulated Evaluation. To appear: *IEEE Transactions on Power Systems*.
8. Bae, M.*, & Krawec, W. O. (2021). Semi-source independent quantum walk random number generation. *Proc. IEEE Information Theory Workshop (ITW)* pp. 1-6. arXiv preprint arXiv:2102.02252.
9. H. Iqbal* & W. O. Krawec (2021). Analysis of a High-Dimensional Extended B92 Protocol. *Quantum Information Processing* vol. 20 (10) pp 1-22. Pre-print available online: arXiv:2106.11460
10. Amer, O.*, Garg, V., and Krawec, W.O. (2021). An Introduction to Practical Quantum Key Distribution. *IEEE Aerospace and Electronic Systems Magazine*, 36(3), pp. 30-55
11. Tang, Z., Zhang, P., & Krawec, W. O. (2021). A Quantum Leap in Microgrids Security: The Prospects of Quantum-Secure Microgrids. *IEEE Electrification Magazine*, 9(1), 66-73.
12. S. Han, W.O. Krawec, and F. Miao. (2020) A Game Theoretic Security Framework for Quantum Cryptography: Performance Analysis and Application. *Quantum Information Processing*, vol. 19 (10), pages 1-24.
13. O. Amer*, W.O. Krawec., and B. Wang. (2020) Efficient Routing for Quantum Key Distribution Networks. *Proc. IEEE Quantum Computing and Engineering (QCE) 2020*, pp. 137-147. pre-print available online: arXiv:2005.12404

14. H. Iqbal* and W.O. Krawec. (2020) High-Dimensional Semi-Quantum Cryptography. *IEEE Transactions on Quantum Engineering* vol. 1, pages 1-17. pre-print available online: arXiv:1907.11340
15. Tang, Z., Zhang, P., Krawec, W.O., and Jiang, Z. (2020). Programmable Quantum Networked Microgrids. *IEEE Transactions on Quantum Engineering* vol. 1 pp 1-13
16. O. Amer* and W.O. Krawec. Finite Key Analysis of the Extended B92 Protocol. *Proc. IEEE International Symposium on Information Theory (ISIT) 2020*, pp. 1944-1948. pre-print available online: arXiv:2001.05940
17. Tang, Z., Qin, Y., Jiang, Z., Krawec, W. O., & Zhang, P. (2020). Quantum-Secure Microgrid. *IEEE Transactions on Power Systems* vol. 36 (2), pp. 1250-1263. arXiv preprint arXiv:2001.02301.
18. Tang, Z., Qin, Y., Jiang, Z., Krawec, W. O., & Zhang, P. (2020). Quantum-secure networked microgrids. In 2020 IEEE Power & Energy Society General Meeting (PESGM) pp. 1-5.
19. W.O. Krawec. A New High-Dimensional Quantum Entropic Uncertainty Relation with Applications. *Proc. IEEE International Symposium on Information Theory (ISIT) 2020*, pp. 1978-1983. pre-print available online: arXiv:2005.04773
20. W.O. Krawec and S.A. Markelon*. A Semi-Quantum Extended B92 Protocol and its Analysis. *Proc. SPIE 11391, Quantum Information Science, Sensing, and Computation XII*, 113910G (24 April 2020)
21. H. Iqbal* and W.O. Krawec. Semi-Quantum Cryptography. *Quantum Information Processing* (2020) 19 (3), 97. pre-print available online: arXiv:1910.05368
22. W.O. Krawec. Quantum Sampling and Entropic Uncertainty. *Quantum Information Processing* (2019) 18 (12), 368. pre-print available online: arXiv:1804.08788
23. W.O. Krawec. Multi-mediated semi-quantum key distribution. In 2019 *IEEE Globecom Workshops (GC Wkshps)* (pp. 1-6). IEEE.
24. O. Amer* and W.O. Krawec. Semi-Quantum Key Distribution with High Quantum Noise Tolerance. *Physical Review A* 100 (2) 022319. pre-print available online: arXiv:1812.04144 (2019)
25. A. Gagliano*, W.O. Krawec, and H. Iqbal*. From Classical to Semi-Quantum Secure Communication. To appear: *Proc. IEEE International Symposium on Information Theory (ISIT) 2019*. pre-print available online: arXiv:1901.01611
26. W.O. Krawec, S. Picek, and D. Jakobovic. Evolutionary Algorithms for the Design of Quantum Protocols. In *Applications of Evolutionary Computation (EvoApplications) 2019*. Lecture Notes in Computer Science, vol. 11454, Springer.
27. W.O. Krawec and E. Geiss*. Semi-Quantum Key Distribution with Limited Measurement Capabilities. *Proc. International Symposium on Information Theory and Its Applications (ISITA)*, Singapore, 2018, pp. 462-466
28. C. Vlachou, W.O. Krawec, P. Mateus, N. Paunkovic, and A. Souto. Quantum Key Distribution with Quantum Walks. *Quantum Information Processing* (2018) 17:288.
29. W.O. Krawec and F. Miao. Game Theoretic Security Framework for Quantum Key

- Distribution. *International Conference on Decision and Game Theory for Security*. Springer, pp. 38-58. (2018)
30. W.O. Krawec. Key-Rate Bound of a Semi-Quantum Protocol Using an Entropic Uncertainty Relation. To appear: *IEEE International Symposium on Information Theory (ISIT)* 2018.
 31. W. O. Krawec and S. A. Markelon*. Genetic Algorithm to Study Practical Quantum Adversaries. *Proc. ACM GECCO 2018*. pp. 1270-1277. (2018)
 32. W. O. Krawec. Practical Security of Semi-Quantum Key Distribution. *Proc. SPIE Quantum Information Science, Sensing, and Computation X. Vol. 10660* (2018).
 33. W.O. Krawec, M.G. Nelson*, E.P. Geiss*. Automatic Generation of Optimal Quantum Key Distribution Protocols. *Proc. ACM GECCO 2017, Berlin (2017)*. pp. 1153-1160.
 34. W.O. Krawec. Quantum Key Distribution with Mismatched Measurements over Arbitrary Channels. *Quantum Information & Computation*. Vol 17, No. 3 and 4, pages 209-241. (2017) Available online: arXiv:1608.07728
 35. W.O. Krawec. An Improved Asymptotic Key Rate Bound for a Mediated Semi-Quantum Key Distribution Protocol. *Quantum Information & Computation*. Vol. 16, No. 9 and 10, pages 813-834 (2016). Available online: arXiv:1509.04797
 36. W.O. Krawec. An Asymptotic Analysis of a Three State Quantum Cryptographic Protocol. *Proc. IEEE International Symposium on Information Theory (ISIT), Barcelona 2016*. Pages 2489 – 2493 (2016). Available online: arXiv:1601.00185
 37. W.O. Krawec. Security of a Semi-Quantum Protocol where Reflections Contribute to the Secret Key. *Quantum Information Processing*, 15 (5), 2067-2090 (2016). Available online: arXiv:1510.07181
 38. W.O. Krawec. A Genetic Algorithm to Analyze the Security of Quantum Cryptographic Protocols. *Proc. IEEE CEC 2016 (Vancouver Canada)*. Pages 2098-2105. (2016)
 39. W.O. Krawec. Security Proof of a Semi-Quantum Key Distribution Protocol. *Proc. IEEE International Symposium on Information Theory (ISIT), Hong Kong 2015*. Pages 686-690 (2015). Available online: arXiv:1412.0282
 40. W.O. Krawec. Mediated Semi-Quantum Key Distribution. *Physical Review A*, 91 032323 (2015). Available online: arXiv:1411.6024
 41. W.O. Krawec. History Dependent Quantum Walk on the Cycle with an Unbalanced Coin. *Physica A: Statistical Mechanics and its Applications*, 428, pages 319-331 (2015). Available online: arXiv:1411.6298
 42. W.O. Krawec. n-Player Impartial Combinatorial Games with Random Players. *Theoretical Computer Science*, 569, pages 1-12 (2015).
 43. W.O. Krawec. Restricted Attacks on Semi-Quantum Key Distribution Protocols. *Quantum Information Processing*, 13 (11), pages 2417-2436 (2014)
 44. W.O. Krawec. On the Application of Quantum Decision Theory to Artificial Life. *Proc. IEEE CEC*, pages 3323-3330, Cancun Mexico (2013)
 45. W.O. Krawec. Regarding Modular Multiplicative Graphs. *Graph Theory Notes of NY LXIV*, pages 45-48. (2013)

46. W.O. Krawec. On the Emergent Behaviors of a Robot Controlled by a Real-Time Evolving Neural Network. *Proc. Of the 13th International Conference on the Simulation and Synthesis of Living Systems (ALife 13)*, pages 364-371, East Lansing MI. (2012)
47. W.O. Krawec. Modular Multiplicative Graphs. *Ars Combinatoria*. Vol. 124, pages 33-40
48. W.O. Krawec. Analyzing n-Player Impartial Games. *International Journal of Game Theory*, 41 (2) pages 345-367 (2012)

Posters and Poster Papers (Peer-Reviewed):

49. W.O. Krawec. Applications of Sampling-Based Entropic Uncertainty Relations. *International Conference on Quantum Communication, Measurement and Computing (QCMC) 2022*.
50. O. Amer*, K. Freyberg*, V. Garg, & W. O. Krawec (2021). A Modular Quantum Key Distribution Software Stack for Rapid Experimental Prototyping. *Proc. IEEE International Conference on Quantum Computing and Engineering (QCE)* pp 467-468.
51. O. Amer*, W. O. Krawec, and B. Wang. (August 2021) Efficient Routing in Quantum Key Distribution Networks with Trusted Nodes and Repeaters. *International Conference on Quantum Cryptography (QCrypt) 2021*.
52. F. Massa, P. Yadav, A. Moqanaki, W. O. Krawec, P. Mateus, N. Paunkovic, A. Souto, P. Walther. Experimental semi-quantum key distribution with classical users. *International Conference on Quantum Cryptography (QCrypt) 2020*.
53. W.O. Krawec. Quantum Sampling and Entropic Uncertainty, with Applications. *9th International Conference on Quantum Cryptography (Qcrypt) 2019*, Montreal Canada.
54. C. Vlachou, W.O. Krawec, P. Mateus, N. Paunkovic and A. Souto Quantum Walks and Quantum Key Distribution. *9th International Conference on Quantum Cryptography (Qcrypt) 2019*, Montreal Canada.
55. W.O. Krawec. Mismatched Measurements and Quantum Key Distribution. *6th International Conference on Quantum Cryptography (QCrypt) 2016*, Washington D.C.
56. W.O. Krawec. An Algorithm for Evolving Multiple Quantum Operators for Arbitrary Quantum Computational Problems. *Proc. ACM GECCO (Companion) 2014*, Vancouver Canada, pages 59-60
57. W.O. Krawec. Minimal Variable Quantum Decision Makers for Robotic Control. *Proc. ACM GECCO (Companion) 2014*, Vancouver Canada, pages 33-34
58. W.O. Krawec. Using Evolutionary Techniques to Analyze the Security of Quantum Key Distribution Protocols. *Proc. ACM GECCO (Companion) 2014*, Vancouver Canada, pages 171-172

Theses:

59. W.O. Krawec. Semi-Quantum Key Distribution: Protocols, Security Analysis, and New Models. Ph.D. Thesis, Stevens Institute of Technology, Hoboken NJ, May 2015
60. W.O. Krawec. Analyzing n-Player Impartial Games. MA Thesis, University at Albany (SUNY), Albany NY, May 2010

Abstracts:

61. W.O. Krawec. Security in the Semi-Quantum Setting. Presented at the AMS/MAA Joint Math Meetings, San Antonio TX, January 2015

Manuscripts:

62. W.O. Krawec. Simulating Quantum Algorithms with Q-Prog.
63. M. Daven and W.O. Krawec. Three-legged Spiders with Even Edge Count are Harmonious

Other (Not Peer-Reviewed) Articles:

64. W.O. Krawec. Evolutionary Robotics (Parts I and II). *Circuit Cellar Ink*. November-December 2015.
65. W.O. Krawec. Experiments in Developmental Robotics (Parts I and II). *Circuit Cellar Ink*. September-October 2013
66. W.O. Krawec. Creating an HC11 OS. *Dr. Dobbs Journal*. December 2008
67. W.O. Krawec. Programming the Pocket PC. *Nuts & Volts Magazine*. June 2006
68. W.O. Krawec. Palm Programming: An Introduction. *Nuts & Volts Magazine*. October 2004
69. W.O. Krawec. An HC11 File Manager. *Circuit Cellar Online*. April-May 2001

Professional Service:

I have served as reviewer for the following journals and conferences:

- *Nature Quantum Information*
- *New Journal of Physics*
- *IEEE Transactions on Information Theory*
- *IEEE Quantum Computing and Engineering Conference*
- *IEEE Information Theory Workshop*
- *Nature Physics*
- *Quantum Information & Computation*
- *SIAM Reviews (SIREV)*
- *IEEE International Symposium on Information Theory (ISIT)*
- *Quantum Information Processing*
- *Theoretical Computer Science*
- *Discrete Mathematics*
- *Discrete Applied Mathematics*
- *Scientific Reports*

I am also a reviewer for the *AMS Mathematical Reviews* and serve on NSF panels.

I am a PC member of the *Attacks and Solutions in Hardware Security (ASHES)* workshop at ACM CCS in 2021 and 2022.

Students:**PhD:**

1. Omar Amer: Fall 2018 – 2022. Now at JP Morgan Chase Bank.
2. Hasan Iqbal: Fall 2018 – present.
3. Minwoo Bae: Fall 2018 – present.

Undergraduate:

1. Adrian Harkness (2022)
2. Saachi Mutreja (2021)
3. Kevin Freyberg (2020-present)
4. Julia Guskind (2019-present)
5. Keegan Yao (2019-2021)
6. Calvin Roth (2019)
7. Allison Gagliano (2018)
8. Alex Masi (2018)
9. Omar Amer (Honor's Student, Spring 2018)
10. Sam Markelon (2017-2020)
11. Michael Nelson (2017)
12. Eric Geiss (2016-2017)