Neal Wagner, Ph.D.

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Citizenship: USA

CAREER PROFILE

Experienced operations research scientist and researcher who utilizes complex systems modeling and simulation, optimization, and AI methods for optimal decision making in real-world problem domains.

- Significant experience as principal investigator/lead scientist for US government funded projects
- Industrial experience as a project manager/team leader/algorithm designer with successful applied AI technology company based in Australia
- Track record of internationally recognized peer-reviewed publications

DECISION OPTIMIZATION SYSTEMS AND PROTOTYPES BUILT

2020 – 2021 Naval Mission Logistics Optimization System Utilizing Commercial Vessels (DARPA):

- Decision system to recommend optimal sealift mission support plans that utilize commercial vessels for stealth
- Lift and deployment plans optimized for multiple objectives such as mission success, resilience, patterns-of-life deviation, and cost
- Lead the core algorithm team to deliver end-user decision system to support sealift planners
- System to support sealift planning and execution phases including plan monitoring and dynamic risk assessment

2019 – 2020 AF Mission Logistics Risk Assessment System (AFRL):

- Novel probabilistic complex system model to assess TACC ability to provide necessary resources for air missions
- Assesses multiple risk metrics including probability of mission success, robustness, resilience, and cost
- Designed the system and led the implementation team
- System captures contingencies/uncertainties in TACC environment such as scheduled and unscheduled missions and unexpected resource outages due to mechanical failure or delivery delay

2018 – 2019 Embedded System Cyber Security Risk Assessment System (AFRL):

- Novel hierarchical complex system model and software system to assess embedded system cyber security risk
- Designed the system, lead the implementation team

- System designed to assess multiple failure modes from both malicious and non-malicious sources

2016 – 2018 Cyber Security Optimization System (Army):

- Intelligent decision system to automatically generate network segmentation architectures that are optimized for security and cost
- Designed the system, lead the implementation team, and managed the project
- System documented in several publications

2013 – 2018 Cyber Security Risk Assessment Systems (DHS, Navy, NSA):

- Multiple novel models and software systems to assess cyber security and mission performance risk for US gov't funded applications
- Designed the systems, lead the implementation teams, and managed the projects
- Assessment systems documented in several publications

2009 – 2010 Demand Forecasting & Replenishment Planning Optimization System:

- Integrated system to predict product demand and automatically replenish stock for over 15K products at 60+ distribution sites for a major food distribution company (PFD Foods) in Australia
- Designed the system, lead the implementation team, and managed the project
- System went live in 2010 with hundreds of stock items replenished daily
- Since deployment the company has seen gross profits grow from $1B to $1.6B AUD
- Prediction component of system documented in publication (see publication #9 in publication list below)

2010 Entertainment Asset Demand Forecasting & Optimization System:

- Integrated system to predict demand for children's coin-operated rides at malls and shopping centers and automatically create ride transfer plans to switch ride locations to keep interest fresh and maximize profit
- Designed the system, lead the implementation team, and managed the project
- System went live in 2010

EDUCATION

1999-2005 **Ph.D., University of North Carolina, Charlotte, NC USA**
Major: Information Technology
Specialization: Evolutionary Algorithms for Optimization
Advisor: Dr. Zbigniew Michalewicz
(http://cs.adelaide.edu.au/~zbyszek/)

1989-1993 **M.S., University of North Carolina, Charlotte, NC USA**
Major: Computer Science

1984-1989 **B.A., University of North Carolina, Asheville, NC USA**
Major: Mathematics (Minor: Physics)

EMPLOYMENT

2021 - Present **Lead Operations Research Scientist**
MITRE
Operations Research Department
Bedford, MA USA

2018 - 2021 **Lead Scientist**
Systems and Technology Research
Analysis and Decision Systems Group
Woburn, MA USA

2013 - 2018 **Technical Research Staff**
Massachusetts Institute of Technology Lincoln Laboratory
Cyber Analytics and Decision Systems Group
Lexington, MA USA

2010 - 2013 **Assistant Professor of Information Systems**
Fayetteville State University
Fayetteville, NC USA

2008 - 2010 **Prediction Software Designer and Project Manager**
SolveIT Software
Adelaide, SA AU

2005 - 2008 **Assistant Professor of Computer Science**
Augusta University
Augusta, GA USA

1999 - 2005 **Instructor of Computer Science & Information Systems**
University of North Carolina
Charlotte, NC USA

1995-1999 **Computer Engineer**
InterGraph Electronics
Mountain View, CA USA

1993-1995 **Instructor of Mathematics and Physics**

U.S. Peace Corps
Zanzibar, Tanzania

NOTABLE CITATIONS

- Article "*Towards Automated Cyber Decision Support: A Case Study on Network Segmentation for Security*" (#27 in below list) is cited in IEEE Security and Privacy March-April 2021, pp. 14-19, vol. 19, "SolarWinds and the Challenges of Patching: Can We Ever Stop Dancing With the Devil?" (https://www.computer.org/csdl/magazine/sp/2021/02/09382358/1saZSdNKK9q)

PATENTS

1. Sahin, C. S., Lychev, R., and Wagner, N., *Systems and methods evaluating password complexity and strength,* publication number WO 2017106669 A1, June 2017, https://www.google.com/patents/WO2017106669A1

BOOKS

2. Shishir K. Shandilya, Neal Wagner, Atulya K. Nagar (editors). **Advances in soft computing techniques for visual information-based systems**. Multimedia Tools Appl 81, 9013 (2022). Springer. https://doi.org/10.1007/s11042-022-12786-3.

3. Shishir K. Shandilya, Neal Wagner, Atulya K. Nagar (editors). **Advances in Cyber Security Analytics and Decision Systems**, Springer, Cham, 2020.

JOURNAL PUBLICATIONS

4. Damodaran, Suresh K., and Neal Wagner. *Modeling and simulation to support cyber defense (editorial article)*. **The Journal of Defense Modeling and Simulation: Applications, Methodology, Technology,** (2020): 3-4.
5. Wagner, N., Şahin, C. Ş., Winterrose, M., Riordan, J., Hanson, D., Peña, J., and Streilein, W. W. *Quantifying the Mission Impact of Network-level Cyber Defensive Mitigations*. **The Journal of Defense Modeling and Simulation: Applications, Methodology, Technology**, Vol. 14, Issue 3, pp. 201-216, 2017.
6. Agrawal, V., Lightner, C., Lightner-Laws, C., and Wagner, N. *A Bi-criteria Evolutionary Algorithm for a Constrained Multi-depot Vehicle Routing Problem*. **Soft Computing**, pp. 1-20, 2016.
7. Lightner-Laws C., Agrawal V., Lightner C., and Wagner N., *An Evolutionary Algorithm Approach for the Constrained Multi-Depot Vehicle Routing Problem*, **International Journal of Intelligent Computing and Cybernetics,** Vol. 9, No. 1 pp. 2-22, 2016.

8. Wagner, N. and Agrawal, V., *An Agent-based Simulation System for Concert Venue Crowd Evacuation Modeling in the Presence of a Fire Disaster*, **Expert Systems with Applications**, Vo1 41, Issue 6, 2014, pp. 2807-2815.
9. Wagner, N. And Agrawal, V., *Using an Evolutionary Algorithm to Solve the Weighted View Materialisation Problem for Data Warehouses*, **International Journal of Intelligent Information and Database Systems**, Vol 7, No. 2, 2013.
10. Wagner, N., Michalewicz, Z., Schellenberg, S., Chiriac, C., and Mohais, A., *Intelligent Techniques for Forecasting Multiple Time Series in Real-world Systems*, **International Journal of Intelligent Computing and Cybernetics**,Vol 4: No. 3, 2011.
11. Wagner, N. and Thompson, M., *Forecasting the Periodic Net Discount Rate with Genetic Programming*, **Journal of Business Valuation and Economic Loss Analysis**: Vol. 4 : Iss. 1, Article 4, 2009.
12. Wagner N., Khouja M., Michalewicz Z., and McGregor R., *Forecasting Economic Time Series with the DyFor Genetic Program Model*, **Applied Financial Economics**,Vol. 18 Issue 5, 2008.
13. Wagner N., Michalewicz Z., Khouja M., and McGregor R., *Time Series Forecasting for Dynamic Environments: the DyFor Genetic Program Model*, **IEEE Transactions on Evolutionary Computation**, Vol. 11 No. 4, 2007.
14. Wagner N. and Brauer J., *Using Dynamic Forecasting Genetic Programming (DFGP) to Forecast U.S. GDP with Military Expenditure as an Explanatory Variable*, **Defence and Peace Economics**, Vol. 18(5), 2007.

BOOK CHAPTERS

15. Winterrose, Michael L., Kevin M. Carter, Neal Wagner, and William W. Streilein. *Adaptive attacker strategy development against moving target cyber defenses*. In **Advances in Cyber Security Analytics and Decision Systems**, pp. 1-14. Springer, Cham, 2020.
16. Wagner N., Sahin C., Pena J., and Streilein W*., Automatic Generation of Cyber Architectures Optimized for Security, Cost, and Mission Performance: A Nature-inspired Approach*, **Advances in Nature-inspired Algorithms and Applications, Springer Series in Computational Intelligence,** Springer, Cham, 2019. 1-25.
17. Schellenberg S., Mohais A., Ibrahimov M., Wagner N., and Michalewicz Z., *A Fuzzy-Evolutionary Approach to the Problem of Optimisation and Decision Support in Supply Chain Networks*, chapter in **Variants of Evolutionary Algorithms for Real-World Applications**, Chiong R., Weise T., and Michalewicz Z. (Eds.), 2012.
18. Mohais A., Schellenberg S., Ibrahimov M., Wagner N., and Michalewicz Z., *An Evolutionary Approach to Practical Constraints in Scheduling: A Case-Study of the Wine Bottling Problem*, chapter in **Variants of Evolutionary Algorithms for Real-World Applications**, Chiong R., Weise T., and Michalewicz Z. (Eds.), 2012.
19. Wagner N. and Michalewicz Z., *Adaptive and Self-adaptive Techniques for Evolutionary Forecasting Applications Set in Dynamic and Uncertain Environments***,** chapter in **Foundations of Computational Intelligence Volume 4: Bio-Inspired**

Data Mining, Series: Studies in Computational Intelligence, Vol. 204 Abraham, Ajith; Hassanien, Aboul-Ella; Carvalho, Andre Ponce de Leon F. de (Eds.), 2009.

20. Wagner N. and Michalewicz Z., *Parameter Adaptation for GP Forecasting Applications*, chapter in **Parameter Setting in Evolutionary Algorithms**, Lima C., Lobo F., and Michalewicz Z. (Eds.), Springer Series Studies in Computational Intelligence, 2007.

CONFERENCE PUBLICATIONS

21. Demoes, N., Nguyen, T., Pena, J., & Wagner, N. (2020, January). *Assessing Mission Performance for Technology Reliant Missions*. In **Proceedings of the 53rd Hawaii International Conference on System Sciences**.
22. Wollaber, Allan, Jaime Peña, Benjamin Blease, Leslie Shing, Kenneth Alperin, Serge Vilvovsky, Pierre Trepagnier, Neal Wagner, and Leslie Leonard. *Proactive Cyber Situation Awareness via High Performance Computing*. In **2019 IEEE High Performance Extreme Computing Conference (HPEC)**, pp. 1-7. IEEE, 2019.
23. Bhattacharya S., Agrawal R., and Wagner N., *Application of deep learning and geo-knowledge bases to scene understanding*, **Proceedings of the 10th International Conference on Management of Digital Ecosystems**, pp. 74-79, ACM, September, 2018.
24. Hemberg E., Zipkin J., Skowyra R., Wagner N., and O'Reilly U.M., *Adversarial Attack and Defense in a Segmented Network Environment*, **Proceedings of the Genetic and Evolutionary Computation Conference Companion,** pp. 1648-1655. ACM, July 2018.
25. Yarbrough B. and Wagner N., *Assessing Security Risk for Wireless Sensor Networks Under Cyber Attack*. **Proceedings of the 2018 ACM Spring Simulation Multi-Conference - Annual Simulation Symposium**, April, 2018.
26. Wagner N., Sahin C S, Pena J., and Streilein W., *A Nature-inspired Decision System for Secure Cyber Network Architecture*. **2017 IEEE Symposium Series on Computational Intelligence (SSCI), Symposium on Computational Intelligence for Security and Defense Applications (CISDA)**, December 2017.
27. Wagner, N., Sahin, C.S., Pena, J., Riordan, J., Neumayer, S., *Capturing the Security Effects of Network Segmentation via a Continuous-time Markov Chain Model*. **Proceedings of the 2017 ACM Spring Simulation Multi-Conference - Annual Simulation Symposium**, April, 2017.
28. Wagner, N., Sahin, C.S., Winterrose, M., Riordan, J., Pena, J., Hanson, D. and Streilein, W.W., *Towards Automated Cyber Decision Support: A Case Study on Network Segmentation for Security*. **2016 IEEE Symposium Series on Computational Intelligence (SSCI), Symposium on Computational Intelligence for Cyber Security (CICS)**, December 2016.
29. Winterrose, M.L., Carter, K.M., Wagner, N. and Streilein, W.W., *Balancing Security and Performance for Agility in Dynamic Threat Environments*. **2016 IEEE/IFIP International Conference on Dependable Systems and Networks (DSN)**, pp. 607-617, July 2016.

30. Wagner N., Sahin C., Hanson D., Pena J., Vuksani E., and Tello B., *Quantitative Analysis of the Mission Impact for Host-Level Cyber Defensive Mitigations*, **Proceedings of the 2016 ACM Spring Simulation Multi-Conference - Annual Simulation Symposium**, April, 2016.
31. Wagner N., Lippmann R., Winterrose M., Riordan J., Yu T., and Streilein W., *Agent-based Simulation for Assessing Network Security Risk due to Unauthorized Hardware*, in **Proceedings of the 2015 ACM Spring Simulation Multi-Conference - Agent Directed Simulation Symposium**, Alexandria, VA, April, 2015.
32. Priest B., Vuksani E., Wagner N., Tello B., Carter K., and Streilein W., *Agent-Based Simulation in Support of Moving Target Cyber Defense Technology Development and Evaluation*, in **Proceedings of the 2015 ACM Spring Simulation Multi-Conference - Communications and Networking Simulation Symposium**, Alexandria, VA, April, 2015.
33. M. L. Winterrose, K. M. Carter, N. Wagner, and W. W. Streilein, *Adaptive Attacker Strategy Development Against Moving Target Cyber Defenses*, in **Proceedings of MODSIM World 2014**, Hampton, VA, April 15-17, 2014.
34. Ibrahimov M., Wagner N., Mohais A., Schellenberg S., and Michalewicz Z., *Comparison of cooperative and classical evolutionary algorithms for global supply chain optimisation,* **Proceedings of the 2010 IEEE World Congress on Computational Intelligence**, Barcelona, Spain, 18-23 July 2010.
35. Mohais A., Schellenberg S., Ibrahimov M., Wagner N., and Michalewicz Z., *Time-varying constraints and other practical problems in real-world scheduling applications,* **Proceedings of the 2010 IEEE World Congress on Computational Intelligence**, Barcelona, Spain, 18-23 July 2010.
36. Schellenberg S., Mohais A., Wagner N., Ibrahimov M., and Michalewicz Z., *Optimising supply chain networks by means of a hybridised simulation-based approach,* **Proceedings of the 2010 IEEE World Congress on Computational Intelligence**, Barcelona, Spain, 18-23 July 2010.
37. Michalewicz Z., Ibrahimov M., Schellenberg S., Mohais A. and Wagner N., *Application of Evolutionary Methods for Complex Industrial Problems*, **Proceedings of EUROGEN 2009**, T. Burczynski and J. Periaux (Eds), 2009.
38. Wagner N. and Michalewicz Z., *An Analysis of Adaptive Windowing for Times Series Forecasting in Dynamic Environments: Further Tests of The DyFor GP Model*, **Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-2008)**, Atlanta, GA, USA, July 12-16, 2008.
39. Carreno E., Leguizamon G., and Wagner N., *Evolution of Classification Rules for Comprehensible Knowledge Discovery*, **Proceedings of the 2007 IEEE Congress on Evolutionary Computation** (CEC-2007), Singapore, September 25-28, 2007.
40. Wagner N. and Brauer J., *Forecasting U.S. GDP and Military Expenditure using Dynamic Forecasting Genetic Programming (DFGP)*, **Proceedings of the 2006 Turkish Economic Association International Conference on Economics**, Ankara, Turkey, September 11-13, 2006.
41. Wagner N., Michalewicz Z., Khouja M., and McGregor R., *Time Series Forecasting for Dynamic Environments: the DyFor Genetic Program Model*, **Proceedings of the 2005 International Seminar on Soft Computing and Intelligent Systems** (WISIS'04), 2005.
42. Wagner N., Michalewicz Z., Khouja M., and McGregor R., *The DyFor Genetic Program Model: Time Series Forecasting with a Dynamic Data Window*,

Proceedings of the 2005 International Symposium on Intelligent Computation and Its Applications, Wuhan, China, April 4-6, 2005.

43. Wagner N., Michalewicz Z., Khouja M., and McGregor R., *Forecasting with a Dynamic Window of Time: the DyFor Genetic Program Model*, **Proceedings of the 2005 International Workshop on Intelligent Media Technology for Communicative Intelligence**, Warsaw, Poland, September 13–14, 2004, Springer-Verlag, Lecture Notes in Computer Science, 2005.
44. Johnson R., Melich M., Michalewicz Z., Schmidt M., and Wagner N., *Coevolutionary Approach for Strategic Decision Support*, **Proceedings of 7th Asia-Pacific Conference on Complex Systems (Complex-2004)**, Cairns, Australia, December 6-10, 2004.
45. Wagner N. and Michalewicz Z., *Genetic Programming with Efficient Population Control for Financial Time Series Prediction*, **Proceedings of the 2001 Genetic and Evolutionary Computation Conference (GECCO-2001)** Late Breaking Papers, San Francisco, CA USA, July 7-11, 2001.

TECHNICAL REPORTS

46. Riordan, J. F., Lippmann, R. P., Neumayer, S. J., & Wagner, N. *A Model of Network Porosity* **(No. TR-1217). MIT Lincoln Laboratory** Lexington United States, 2016.

POSTERS

47. Wagner N., DiRenzo J., and Maule B., *Resource Allocation Optimization in Alien Migration Interdiction Operations Using an Evolutionary Algorithm Technique*, presented at **The 2012 USCG/CREATE Maritime Risk Symposium**, University of Southern California, Los Angeles, CA, November 14-16, 2012.
48. Wagner, N. and Agrawal, V., *Emergency Decision Support Using an Agent-based Modeling Approach*, **Proceedings of the 2012 IEEE International Conference on Intelligence and Security Informatics**, Washington, DC, June 11-14, 2012.
49. Stringham, E. and Wagner, N. *Property Rights Without the State: The Emergence of Property Among Agent Based Whalers*, presented at **The 37th Annual Conference of The Association of Private Enterprise Education (APEE-2012)**, Las Vegas, NV, April 1-3, 2012.

HONORS AND AWARDS

- **Outstanding Paper of the Year** (Awarded in May 2017) - International Journal of Intelligent Computing and Cybernetics. Paper: *An Evolutionary Algorithm Approach for the Constrained Multi-Depot Vehicle Routing Problem (2016).*

- **Best Paper Award** - 2017 Spring Simulation Multi-conference Annual Simulation Symposium. Paper: *Capturing the Security Effects of Network Segmentation via a Continuous-time Markov Chain Model.*
- **Best Paper Runner-up Award** - 2016 Spring Simulation Multi-conference Annual Simulation Symposium. Paper: *Quantitative Analysis of the Mission Impact for Host-Level Cyber Defensive Mitigations.*
- **Best Paper Award** - 2015 Spring Simulation Multi-conference Agent-Directed Simulation Symposium. Paper: *Agent-based Simulation for Assessing Network Security Risk due to Unauthorized Hardware.*
- **Most Downloaded Paper of the Year** (Awarded in May 2012) - International Journal of Intelligent Computing and Cybernetics. Paper: *Intelligent Techniques for Forecasting Multiple Time Series in Real-world Systems (2011).*