

Peter A. Beling

Department of Engineering Systems and Environment Phone: 434-982-2066
School of Engineering Fax: 434-982-2972
University of Virginia E-mail: beling@virginia.edu
Charlottesville, VA 22903-2442

EDUCATION

- Ph.D., University of California at Berkeley, Industrial Engineering and Operations Research, December 1991.
Dissertation advisor: Ilan Adler.
- M.S., George Washington University, Operations Research, May 1987.
- B.A., University of Virginia, Mathematics, December 1984.

PROFESSIONAL APPOINTMENTS

- Professor and Associate Chair for Research, Department of Engineering Systems and Environment, University of Virginia, 2018–present.
- Professor and Interim Chair, Department of Systems and Information Engineering, University of Virginia, 2017–2018.
- Assistant Professor, Associate Professor, Professor; Department of Systems and Information Engineering, University of Virginia, 1993–2017.
- Faculty Member, Link Lab (for cyber-physical systems research), University of Virginia, 2017–present.
- Faculty Affiliate, Data Science Institute, University of Virginia, 2015–present.
- Honorary Professor, Department of Finance and Tax, University of Cape Town, South Africa, 2015–present.
- Research Associate, IBM Almaden Research Center, San Jose, CA, 1992–1993.
- Lecturer, Industrial Engineering and Operations Research Department, University of California at Berkeley, 1992–1992.
- Research Assistant, Center for Naval Analyses, Alexandria, VA, 1985–1988.

LEADERSHIP HIGHLIGHTS¹

- Associate Chair for Research, Department of Engineering Systems and Environment – Lead for all aspects of research in the department, including leadership or oversight of all tenure track faculty searches, administrative approval of cost-share and proposals, marketing and outreach for research programs, development of seed funding and large-scale collaborative programs, and supervision of departmental research administration staff.
- Interim Chair, Department of Systems and Information Engineering –
 - Co-lead in the creation of a new department, Engineering Systems and Environment, that effectively merged systems and civil engineering faculties. This venture received substantial investment in the form of faculty lines, and the department is now among the largest in the Engineering School in terms of faculty (43) and magnitude of research activity (\$10.6m annual expenditures).
 - Appointed promotion and tenure committee and wrote nomination letters for candidates. Successful cases included tenure for the department’s only female assistant professor.
 - Oversight of multiple faculty search committees. Successfully negotiated faculty hires at assistant and full professor levels, including two hires from underrepresented groups, and two hires with joint appointments in two UVA schools.
- Graduate Program Director, Department of Systems and Information Engineering (3 years) – Responsible for management of graduate program with an average of 80 research students. Led substantial revision of doctoral course requirements; re-engineered allocation policies for teaching assistants.
- Undergrad Program Director, Department of Systems and Information Engineering (6 years) – Responsible for management of undergraduate program with an average of annual class size of 110 students. Successfully led program through ABET accreditation.
- Budget Committee Chair, Department of Systems and Information Engineering (8 years) – Worked with Chair to develop department budgets. Approved faculty and staff requests for resources. Developed plans for strategic investments in graduate and research programs to foster growth.
- Search Committee Chair – Chair for several successful faculty searches, both in my department and as part of cross-cutting or interdisciplinary initiatives.

¹Details on leadership and service can be found in the section "Service to the University and Profession, toward the end of the document.

- Co-Director, Program on Assured Artificial Intelligence, Commonwealth Cyber Initiative – As part of 2019-20 sabbatical leave, developing new, state-wide research program focused on ways to make learning-based systems more trusted and trustworthy. This program is one of the main thrusts for a \$20m annual investment by the Commonwealth of Virginia in building its cyber economy.
- Established UVA site, Center for Visual and Decision Informatics, an NSF Industry/University Cooperative Research Center.
- Founding Director of the Adaptive Decision Systems Laboratory, with focus on decision making and control and prognostics and health management in smart manufacturing environments and other cyber-physical systems.
- Initiated research program in machine learning and artificial intelligence approaches to process monitoring and health management the Commonwealth Center for Advanced Manufacturing (CCAM); UVA representative to CCAM operations board.
- Co-founder of the Financial Decision Engineering Research Group, with focus on simulation and control models for equities, commodities, and derivatives.
- Founder of the Financial Engineering Research Group, with focus on credit scoring and other risk-based decision problems in consumer credit.
- 2018 graduate of UVA’s Leadership in Academic Matters program, which provides in-depth training over a semester in topics ranging from university budgeting to diversity to media interviews.

PUBLICATIONS AND SCHOLARLY WORK²

Archival Peer Reviewed Journal Articles

1. Lin, X., Adams, S., and **Beling, P.**, “Multi-agent Inverse Reinforcement Learning for Certain General-sum Stochastic Games,” *Journal of Artificial Intelligence Research*, to appear 2019.
2. Adams, S., Meekins, R., **Beling, P.**, Farinholt, K., Brown, N., Polter, S., and Dong, Q., “Hierarchical Fault Classification for Resource Constrained Systems,” *Mechanical Systems and Signal Processing*, to appear, 2019.
3. **Beling, P.**, Fleming, C., and Scherer, W., “Systems Engineering in Context,” *Environment Systems & Decisions*, pp. 1–2, 2019.

²The names of P. Beling’s advisees are underlined.

4. Adams, S., Greenspan, S., Velez-Rojas, M., Mankovski, S., and **Beling, P.**, “Data-driven Simulation for Energy Consumption Estimation in a Smart Home,” *Environment Systems & Decisions*, pp. 1–14, 2019. DOI: 10.1007/s10669-019-09727-1
5. Carter, B., Adams, S., Bakirtzis, G., Sherburne, T., **Beling, P.**, Horowitz, B., and Fleming, C., “A Preliminary Design-Phase Security Methodology for Cyber-Physical Systems,” *Systems*, **7** (2), pp. 1–22, 2019. DOI: 10.3390/systems7020021
6. Lee, K., Ulkuatam, S., **Beling**, and Scherer, W., “Generating Synthetic Bitcoin Transactions and Predicting Market Price Movement via Inverse Reinforcement Learning and Agent- Based Modeling,” *Journal of Artificial Societies and Social Simulation*, **21**(3) 5, 2018. DOI: 10.18564/jasss.3733
7. Scherer, W., Adams, S., and **Beling, P.**, “On the Practical Art of State Definitions for Markov Decision Process Construction,” *IEEE Access*, **6**, pp. 21115–21128, 2018. DOI: 10.1109/ACCESS.2018.2819940
8. Hayes, R. and **Beling, P.**, “Unsupervised Hierarchical Clustering of Build Orders in a Real-Time Strategy Game,” *The Computer Games Journal*, **7**(1), pp. 5–26, 2018. DOI:10.1007/s40869-018-0051-1
9. Adams, S. and **Beling, P.**, “A Survey of Feature Selection Methods for Gaussian Mixture Models and Hidden Markov Models,” *Artificial Intelligence Review*, pp. 1–41, 2017.
10. Adams, S., Malinowski, M., Heddy, G., Choo, B., and **Beling, P.**, “The WEAR Methodology for PHM Implementation,” *Journal of Manufacturing Systems*, **45**, pp. 82–96, 2017.
11. Lin, X., **Beling, P.**, and Cogill, R., “Multiagent Inverse Reinforcement Learning for Two-Person Zero-Sum Games,” *IEEE Transactions on Games*, **10**(1), pp. 56–68, 2018.
12. Landau, M., and **Beling, P.**, “Optimal Model-Based (3D/6D) Pose Estimation with Structured-Light Depth Sensors,” *IEEE Transactions on Computational Imaging*, **3**(1), pp. 58–73, 2017. DOI: 10.1109/TCI.2016.2646220
13. Rajaratnam, K., **Beling, P.**, and Overstreet, G., “Regulatory Capital Decisions in the Context of Consumer Loan Portfolios,” *Journal of the Operational Research Society*, **68**(7), pp. 847–858, 2017.
14. Paddrik, M., Hayes, R., Scherer, W., and **Beling, P.**, “Effects of Limit Order Book Information Level on Market Stability Metrics,” *Journal of Economic Interaction and Coordination*, **12**(2), pp. 221–247, 2017.
15. Rajaratnan, K., **Beling, P.**, and Overstreet, G., “Models of Sequential Decision Making in Consumer Lending,” *Decision Analytics*, **3**(1), 6 pages, 2016.

16. Choo, B., Adams, S., Weiss, B., Marvel, J., and **Beling, P.**, “Adaptive Multi-scale PHM for Smart Manufacturing Systems,” *International Journal of Prognostics and Health Management*, pp. 1–15 (published online), 2016.
17. Paddrik, M., Haynes, R., Todd, A., Scherer, W. and **Beling, P.**, “Visual Analysis to Support Regulators in Electronic Order Book Markets,” *Environment Systems & Decisions*, **36**(2), pp. 167–182, 2016.
18. Qiao, Q. and **Beling, P.**, “Decision Analytics and Machine Learning in Economic and Financial Systems,” *Environment Systems & Decisions*, pp.109–113, 2016.
19. Adams, S., **Beling, P.**, and Cogill, R., “Feature Selection for Hidden Markov Models and Hidden Semi-Markov Models,” *IEEE Access*, **4**, pp. 1642–1657, 2016.
20. Todd, A., **Beling, P.**, and Scherer, W., “Crossed and Locked Quotes in a Multi-market Simulation,” *PLoS ONE*, 11(3): e0151096, 19 pages, 2016.
21. Reyes, I., **Beling, P.**, and Horowitz, B., “Adaptive Multi-scale Optimization: Concept and Case Study on Simulated UAV Surveillance Operations,” *IEEE Systems Journal*, **11**(4), pp.1947–1958, 2015.
22. Landau, M., Choo, B., and **Beling, P.**, “Simulating Kinect Infrared and Depth Images,” *IEEE Transactions on Cybernetics*, **46**, No. 12, pp. 3018–3031, 2016.
23. Rude, D., Adams, S., and **Beling, P.**, “Task Recognition from Joint Tracking Data in an Operational Manufacturing Cell,” *Journal of Intelligent Manufacturing*, **29**: 1203, 2018. <https://doi.org/10.1007/s10845-015-1168-8>.
24. **Beling, P.**, Scherer, W., and White, C., “Introduction to the Feature Cluster in Memory of Douglas J. White,” *Journal of the Operational Research Society*, **66**, pp. 1589–1594, 2015.
25. Sanderford, A., Overstreet, G., **Beling, P.** and Rajaratnam, K. “Energy Efficient Homes and Mortgage Risk: Crossing the Chasm At Last?,” *Environment Systems & Decisions*, **35**, pp. 157–168, 2015.
26. Yang, S., Qiao, Q., **Beling, P.**, Scherer, W., and Kirilenko, A., “Gaussian Process-Based Algorithmic Trading Strategy Identification,” *Quantitative Finance*, **15**(10), pp. 1683–1703, 2015.
27. Gao, L., Rajaratnam, K., and **Beling, P.**, “Loan Origination Decisions using a Multinomial Scorecard,” *Annals of Operations Research*, pp. 1–12, 2015.
28. Choo, B., Landau, M., DeVore, M., and **Beling, P.**, “Statistical Analysis Based Stochastic Error Models for the Microsoft Kinect Depth Sensor,” *Sensors*, **14**(9), pp. 17430–17450, 2014.

29. Birisan, M. and **Beling, P.**, “A Multi-Instance Learning Approach to Filtering Images for Presentation to Analysts,” *Environment Systems & Decisions*, **34**(3), pp. 406–416, 2014; doi=10.1007/s10669-014-9512-7.
30. Hayes, R., Wu, J., Chaysiri, R., Bae, J., **Beling, P.**, and Scherer, W., “Effects of Time Horizon and Asset Condition on the Profitability of Technical Trading Rules,” *Journal of Economics and Finance*, **40**(1), pp. 41–59, 2016 (first online: June 2014). (Note J. Wu, R. Chaysiri, and J. Bae were undergraduate research assistants.)
31. **Beling, P.**, “Multi-scale Decision Making: Challenges in Engineering and Environmental Systems,” *Environment Systems & Decisions*, **33**(3), pp. 323–325, 2013.
32. Hayes, R., **Beling, P.**, and Scherer, W., “Action-Based Feature Representation for Reverse Engineering Trading Strategies,” *Environment Systems & Decisions*, **33**(3), pp. 413–426, 2013.
33. Luckett, B., Jones, R., **Beling, P.** and Horowitz, B., “Architectural Scoring Framework for the Creation and Evaluation of System-Aware Cyber Security Solutions,” *Environment Systems & Decisions*, **33**(3), pp. 341–361, 2013.
34. Rubin, G., Rajaratnam, K., Overstreet, G., and **Beling, P.**, “A Dynamic Theory of the Credit Union,” *Annals of Operations Research*, **205**(1), pp. 29–53, 2013.
35. **Beling, P.**, Horowitz, B., Bose, T., and Volos, H., “Content-based Filtering and Adaptation at the Application Layer in Video Surveillance Systems,” *IEEE Communications Society Multimedia Communications Technical Committee E-Letter*, **7**(4), pp. 20–23, 2012.
36. Rajaratnam, K., **Beling, P.**, and Overstreet, G., “Scoring Decisions in the Context of Economic Uncertainty,” *Journal of the Operational Research Society*, **61**, pp. 421–429, March 2010.
37. **Beling, P.**, Overstreet, G., and Rajaratnam, K., “Estimation Error in Regulatory Capital Requirements: Theoretical Implications for Consumer Bank Profitability,” *Journal of the Operational Research Society*, **61**, pp. 381–392, 2010.
38. Zhao, Y., Patek, S., and **Beling, P.**, “Decentralized Bayesian Search using Approximate Dynamic Programming Methods,” *IEEE Transactions on Systems, Man and Cybernetics, Part B*, **38**(4), pp. 970–975, 2008.
39. Morris, A. T. and **Beling, P.**, “Extracting Acyclic Dependency Models from Quality Standards for COTS Software Evaluation,” *Journal of Aerospace Computing, Information, and Communication*, **3**(7), pp. 327–339, 2006.
40. **Beling, P.**, Covaliu, Z., and Oliver, R., “Optimal Scoring Policies and Efficient Frontiers,” *Journal of the Operational Research Society*, **56**(9), pp. 1016–1029, 2005.

41. Zhu, H., **Beling, P.**, and Overstreet, G., "A Bayesian Framework for the Combination of Classifier Outputs," *Journal of the Operational Research Society*, **53**(7), pp. 719–727, 2002.
42. Zhu, H., **Beling, P.**, and Overstreet, G., "A Study in the Combination of Consumer Credit Scores," *Journal of the Operational Research Society*, **52**(9), pp. 974–980, 2001.
43. **Beling, P.**, "Exact Algorithms for Linear Programming over Algebraic Extensions," *Algorithmica*, **31**(4), pp. 459–478, 2001.
44. **Beling, P.** and Verma, S., "A Probabilistic Analysis of a Measure of Combinatorial Complexity for the Central Curve," *Mathematical Programming*, **87**(1), pp. 177–187, 2000.
45. Olsen, R., **Beling, P.**, and Lambert, J., "Dynamic Models for Floodplain Management," *Journal of Water Resources Planning and Management*, **126**(3), pp. 167–175, 2000.
46. Olsen, R., **Beling, P.**, Lambert, J., and Haimes, Y., "Input-Output Economic Evaluation of System of Levees," *Journal of Water Resources Planning and Management*, **24**(5), pp. 237–245, 1998.
47. **Beling, P.** and Megiddo, N., "Using Fast Matrix Multiplication to Find Basic Solutions," *Theoretical Computer Science*, **205**(1), pp. 307–316, 1998.
48. Adler, I. and **Beling, P.**, "Polynomial Algorithms for Linear Programming over the Algebraic Numbers," *Algorithmica*, **12**(6), pp. 436–457, 1994.
49. Adler, I. and **Beling, P.**, "Polynomial Algorithms for LP over a Subring of the Algebraic Integers with Applications to LP with Circulant Matrices," *Mathematical Programming*, **57**(2), pp. 121–143, 1992.

Archival Peer Reviewed Conference Proceedings

1. Cody, T., Adams, S., and **Beling, P.**, "A Systems Theoretic Perspective on Transfer Learning," *Proceedings of IEEE SysCon 2019*, to appear, 2019. *Winner of the Best Student Paper Award.*
2. Farinholt, K., Chaudhry, A., Kim, M., Thompson, E., Hipwell, N., Meekins, R., Adams, S., **Beling, P.**, and N., Polter, S., "Developing Health Management Strategies Using Power Constrained Hardware," *Proceedings of the 2018 Annual Conference of the Prognostics and Health Management Society*, **10** (1), 2018.
3. Adams, S., Crannell, G., Bolcavage, A., McIntyre, R., and **Beling, P.**, "A Condition Monitoring System for Low Vacuum Plasma Spray using Computer Vision," *Proceedings of the 2018 IEEE International Conference on Prognostics and Health Management (ICPHM)*, pp. 1-7, 2018. doi: 10.1109/ICPHM.2018.8448464

4. Adams, S., Meekins, R., Farinholt, K., Hipwell, N., Desrosiers, M., and **Beling, P.**, “One-Class Support Vector Machines for Structural Health Monitoring on Wave Energy Converters,” *Proceedings of the 2018 IEEE International Conference on Prognostics and Health Management (ICPHM)*, pp. 1-8, 2018. doi: 10.1109/ICPHM.2018.8448829
5. Meekins, R., Adams, S., **Beling, P.**, Farinholt, K., Hipwell, N., Chaudhry, A., Polter, S., and Dong, Q., “Cost-sensitive Classifier Selection when there is Additional Cost Information,” *Proceedings of The International Workshop on Cost-Sensitive Learning*, **88**, pp.17–30, 2018.
6. Adams, S., **Beling, P.**, Greenspan, S., Velez-Rojas, M., and Mankovski, S., “Model-Based Trust Assessment for Internet of Things Networks,” *Proceedings of the 2018 17th IEEE International Conference On Trust, Security And Privacy In Computing And Communications/ 12th IEEE International Conference On Big Data Science and Engineering (TrustCom/BigDataSE)*, pp. 1838-1843, 2018. doi: 10.1109/TrustCom/BigDataSE.2018.00278
7. Adams, S., Carter, B., Fleming, C., and **Beling, P.**, “Selecting System Specific Cybersecurity Attack Patterns Using Topic Modeling,” *Proceedings of the 2018 17th IEEE International Conference On Trust, Security And Privacy In Computing And Communications/ 12th IEEE International Conference On Big Data Science and Engineering (TrustCom/BigDataSE)* pp. 490-497, 2018. doi: 10.1109/TrustCom/BigDataSE.2018.00076
8. Wang, Y., Adams, S., **Beling, P.**, Greenspan, S., Rajagopalan, S., Velez-Rojas, M., Mankovski, S., Boker, S., Brown, D., “Privacy Preserving Distributed Deep Learning and Its Application in Credit Card Fraud Detection,” *Proceedings of the 2018 17th IEEE International Conference On Trust, Security And Privacy In Computing And Communications/ 12th IEEE International Conference On Big Data Science and Engineering (TrustCom/BigDataSE)*, pp. 1070-1078, 2018. doi: 10.1109/TrustCom/BigDataSE.2018.00150
9. Lee, K., Rucker, M., Scherer, W., **Beling, P.**, Gerber, M., and Kang, H., “Agent-based Model Construction using Inverse Reinforcement Learning,” *Proceedings of the 2017 Winter Simulation Conference (WSC 2017)*, pp. 1264–1275, 2017.
10. Choo, B., Adams, S., and **Beling, P.**, “Health-aware Hierarchical Control for Smart Manufacturing using Reinforcement Learning,” *Proceedings of the 2017 IEEE International Conference on Prognostics and Health Management (ICPHM 2017)*, 2017.
11. Adams, S., Meekins, R., and **Beling, P.**, “An Empirical Evaluation of Techniques for Feature Selection with Cost,” *Proceeding s of the 2017 IEEE International Conference on Data Mining Workshops (ICDMW)*, pp. 834–841, 2017.
12. Adams, S., Meekins, R., **Beling, P.**, Farinholt, K., Brown, N., Polter, S., and Dong, Q., “Comparison of Feature Selection and Feature Extraction Techniques for Condition

- Monitoring of a Hydraulic Actuator,” *Proceedings of the 2017 Annual Conference of the Prognostics and Health Management Society*, 2017.
13. Meekins, R., Adams, S., K Farinholt, Hipwell, N., Desrosiers, M., and **Beling, P.**, “Impact Damage Classification for Wave Energy Converters,” *Proceedings of the 2017 Annual Conference of the Prognostics and Health Management Society*, 2017.
 14. Cody, T., Adams, S., and **Beling, P.**, “ Unsupervised Deep Learning for Gear Health Monitoring,” *Proceedings of the 2017 Annual Conference of the Prognostics and Health Management Society*, 2017.
 15. Todd, A., **Beling, P.**, and Scherer, W., “Agent-based Financial Markets: A review of the Methodology and Domain,” *2016 IEEE Symposium Series on Computational Intelligence: IEEE Symposium on Computational Intelligence for Financial Engineering & Economics*, pp. 1–5, 2016.
 16. Adams, S., **Beling, P.**, Farinholt, K., Brown, N., Polter, S., and Dong, Q., “Condition-based Monitoring for a Hydraulic Actuator,” *2016 Annual Conference of the Prognostics and Health Management Society*, pp. 1–6, 2016.
 17. Farinholt, K., Desrosiers, M., Kim, M., Friedersdorf, F., Adams, S., **Beling, P.**, Hughes, S., and Post, N., “Active Sensing and Damage Classification for Wave Energy Converter Structural Composites,” *Proceedings of the ASME 2016 Conference on Smart Materials, Adaptive Structures and Intelligent Systems (SMASIS 2016)*, pp. V001T05A020–V001T05A020, 2016.
 18. Todd, A., **Beling, P.**, and Scherer, W., “Order Routing and Arbitrage Opportunities in a Multi-Market Trading Simulation,” *2015 IEEE Symposium Series on Computational Intelligence: IEEE Symposium on Computational Intelligence for Financial Engineering & Economics*, pp. 1774–1777, 2015.
 19. Heddy, G., Huzaiifa, U., **Beling, P.**, Haimes, Y., Marvel, J., Weiss, B., and LaViers, A., “Linear Temporal Logic (LTL) Based Monitoring of Smart Manufacturing Systems,” *2015 Annual Conference of the Prognostics and Health Management Society*, 2015.
 20. Malinowski, M., **Beling, P.**, Haimes, Y., LaViers, A., Marvel, J., and Weiss, B., “System Interdependency Modeling in the Design of Prognostic and Health Management Systems in Smart Manufacturing,” *2015 Annual Conference of the Prognostics and Health Management Society*, 2015.
 21. Choo, B., LaViers, A., Marvel, J., Weiss, B., and **Beling, P.**, “Adaptive Multi-scale PHM for Robotic Assembly Processes,” *2015 Annual Conference of the Prognostics and Health Management Society*, 2015.
 22. Adams, S., **Beling, P.**, and Cogill, R., “Infusing Prior Knowledge into Hidden Markov Models,” *2015 European Conference on Machine Learning and Principles and Practices of Knowledge Discovery in Databases (ECML-PKDD 2015)*, 2015.

23. Todd, A., **Beling, P.**, and Scherer, W., “Agent-based Model for Order Routing and Financial Market Integration,” *Trends in Practical Applications of Agents, Multi-Agent Systems and Sustainability: The PAAMS Collection*, pp. 19-26, 2015.
24. Rude, D., Adams, S., and **Beling, P.**, “A Benchmark Dataset for Depth Sensor Based Activity Recognition in a Manufacturing Process,” *Proceedings of the 15th IFAC Symposium on Information Control Problems in Manufacturing (INCOM 2015)*, IFAC-PapersOnLine, **48**(3), pp. 668–674, 2015.
25. Todd, A., Scherer, W., **Beling, P.**, Paddrik, M., and Haynes, R., “Visualizations for Sense-making in Financial Market Regulation,” *Proceeding of the 2014 IEEE International Conference on Big Data (IEEE BigData 2014)*, pp. 730–735, 2014.
26. Hayes, R., Todd, A., Chaidarun, N., Tepsuporn, S., Grazioli, S., **Beling, P.**, and Scherer, W., “An Agent-based Financial Simulation for Use by Researchers,” *Proceedings of the 2014 Winter Simulation Conference*, pp. 300–309, 2014.
27. Chaidarun, N., Tepsuporn, S., Hayes, R., Grazioli, S., **Beling, P.**, and Scherer, W., “Computational Intelligence in Financial Engineering: A System for Project-based Learning,” *Proceedings of the 2014 Winter Simulation Conference*, pp. 3552–3556, 2014.
28. Hayes, R., **Beling, P.**, and Scherer, W., “The Need for a Real Time Strategy Game Language,” *Proceedings of the 2014 Winter Simulation Conference*, pp. 3495–3504, 2014.
29. Choo, B., DeVore, M. and **Beling, P.**, “Statistical Models of Horizontal and Vertical Stochastic Noise for the Kinect Sensor,” *Proceedings 2014 IEEE Conference on Industrial Electronics (IECON14)*, pp. 2624–2630, 2014.
30. Landau, M., DeVore, M. and **Beling, P.**, “Efficacy of Statistical Model-Based Pose Estimation of Rigid Objects with Corresponding CAD Models using Commodity Depth Sensors,” *Proceedings 2014 IEEE Conference on Industrial Electronics (IECON14)*, pp. 3445–3451, 2014.
31. Yang, S., Qiao, Q., **Beling, P.**, and Scherer, W., “Algorithmic Trading Behavior Identification Using Reward Learning Method,” *Proceedings 2014 International Joint Conference on Neural Networks (IJCNN 2014)*, 2014 IEEE World Congress on Computational Intelligence, 2014.
32. Todd, A., Hayes, R., **Beling, P.**, and Scherer, W., “Micro-price Trading in an Order-driven Market,” *Proceedings 2014 IEEE Symposium on Computational Intelligence for Financial Engineering and Economics (CIFER 2014)*, 2014.
33. Qiao, Q. and **Beling, P.**, “Recognition of Agents from Observation of Their Sequential Behavior,” *2013 European Conference on Machine Learning and Principles and Practices of Knowledge Discovery in Databases (ECML-PKDD 2013)*, pp. 33–48, 2013.

34. Hayes, R., Paddrik, M., Todd, A., Yang, S., **Beling, P.**, and Scherer, W., “Agent Based Model of the E-MINI Future Market: Applications to Policy Decisions,” *2012 Winter Simulation Conference (WSC 2012)*, pp. 1–12, 2012. *Winner of the Best Applied Paper Award.*
35. Yang, S., Paddrik, M., Hayes, R., Todd, A., Kirilenko, A., **Beling, P.**, and Scherer, W., “Behavior Based Learning in Identifying High Frequency Trading Strategies,” *Proceedings 2012 IEEE Symposium on Computational Intelligence for Financial Engineering and Economics (CIFER 2012)*, 2012. *Honorable Mention for Best Paper Award.*
36. Paddrik, M., Hayes, R., Todd, A., Yang, S., **Beling, P.**, and Scherer, W., “An Agent Based Model of the E-Mini S&P 500: Applied to Flash Crash Analysis,” *Proceedings 2012 IEEE Symposium on Computational Intelligence for Financial Engineering and Economics (CIFER 2012)*, 2012.
37. Qiao, Q. and **Beling, P.**, “Classroom Video Assessment and Retrieval via Multiple Instance Learning,” in *Artificial Intelligence in Education: 15th International Conference (AIED 2011)*, Biwas, G., Bull, S., Kay, J., Mitrovic, A., eds., Lecture Notes in Artificial Intelligence, **6738**, Springer, pp. 272–279, 2011.
38. Qiao, Q. and **Beling, P.**, “Inverse Reinforcement Learning with Gaussian Processes,” *2011 American Control Conference (ACC 2011)*, pp. 113–118, 2011.
39. Qiao, Q. and **Beling, P.**, “Localized Content Based Image Retrieval with Self-taught Multiple Instance Learning,” *IEEE International Conference on Data Mining Workshops*, pp. 170–175, 2009.
40. Patek, S., **Beling, P.**, and Zhao, Y., “Natural Solutions for a Class of Symmetric Games,” in *Game Theoretic and Decision Theoretic Agents: Papers from the AAAI Spring Symposium*, AAAI Press, Technical Report SS-07-02, pp. 47–53, 2007.
41. Gao, L. and **Beling, P.**, “Machine Quantification of Text-based Economic Reports for use in Predictive Modeling,” *Proceedings of the 2003 IEEE Conference on Systems, Man, and Cybernetics (SMC 2003)*, pp. 3536–3541, 2003.
42. Kim, A., Partee, N., Reynolds, T., Santamaria, M., and **Beling, P.**, “Patent Litigation Risk Scoring Model,” *Proceedings of the 2002 IEEE Conference on Systems, Man, and Cybernetics*, pp. 13–17, 2002.
43. Morris, A.T. and **Beling, P.**, “Space Shuttle RTOS Bayesian Network,” *Digital Avionics Systems (DASC) 20th Conference*, pp. 4D5/1–4D5/13, 2001.
44. Chalasan, V. and **Beling, P.**, “Optimization-based Decision Trees for Multi-modal Problems,” *Proceedings of the 2000 IEEE Conference on Systems, Man and Cybernetics (SMC 2000)*, pp. 2269–2274, 2000.

45. Chalasanani, V. and **Beling, P.**, "Contribution-based Approach for Feature Selection in Linear Programming-based Models," *Proceedings of the 2000 IEEE Conference on Systems, Man and Cybernetics (SMC 2000)*, pp. 1939–1943, 2000.
46. Zhu, H. and **Beling, P.**, "A Meta-Gaussian Approach to Learning Non-Gaussian Bayesian Network Structure," *Proceedings of the 2000 IEEE Conference on Systems, Man and Cybernetics (SMC 2000)*, pp. 1949–1954, 2000.
47. Albright, H. and **Beling, P.**, "A Decision-theoretic View of Multiobjective Evolutionary Algorithms," *Proceedings of the 5th International Meeting of the Decision Sciences Institute*, pp. 127–130, 1999.
48. Blanco, Y., Zhu, H., and Beling, P., "A Study in the Combination of Consumer Credit Scores," *Proceedings of the 5th International Meeting of the Decision Sciences Institute*, pp. 481-486, 1999.
49. Chalasanani, V. and **Beling, P.**, "Road Extraction using Linear Programming and Cost Functions," *Proceedings of the 4th International Conference on GeoComputation*, 10 pages, 1999.
50. Mullei, S. and **Beling, P.**, "Hybrid Evolutionary Algorithms for a Multiobjective Financial Problem", *Proceedings of the 1998 IEEE Conference on Systems, Man and Cybernetics (SMC 1998)*, pp. 3925–3930, 1998.
51. **Beling, P.** and Verma, S., "A Fast Symmetric Penalty Algorithm for the Linear Complementarity Problem", *Proceedings of the 1998 IEEE Conference on Systems, Man and Cybernetics (SMC 1998)*, pp. 2950–2955, 1998.
52. Tran, L. and **Beling, P.**, "A Heuristic for the Topological Design of Two-tiered Networks", *Proceedings of the 1998 IEEE Conference on Systems, Man and Cybernetics (SMC 1998)*, pp. 2962–2967, 1998.
53. Mullei, S. and **Beling, P.**, "Induction of Rule-based Scoring Functions", *Proceedings of the 1998 IEEE Conference on Systems, Man and Cybernetics (SMC 1998)*, pp. 2968–2973, 1998.
54. Chalasanani, V. and **Beling, P.**, "Optimization-based Classifiers for Multi-modal Problems in Road Extraction", *Proceedings of the 1998 IEEE Conference on Systems, Man and Cybernetics (SMC 1998)*, pp. 2938–2943, 1998.
55. Chalasanani, V. and **Beling, P.**, "Tensorized Nearest-Neighbor Classifiers", *Proceedings of the 1998 IEEE Conference on Systems, Man and Cybernetics (SMC 1998)*, pp. 2913–2916, 1998.
56. Albright, H. and **Beling, P.**, "A Test Problem Generation Methodology for Nonlinear Goal Programming," *Proceedings of the 1997 IEEE Conference on Systems, Man and Cybernetics (SMC 1997)*, pp. 151–158, 1997.

57. **Beling, P.** and Verma, S., “Combinatorial Complexity of the Central Path,” *Proceedings of the 29th Annual ACM Symposium on the Theory of Computing (STOC 1997)*, pp. 250–255, 1997.
58. Adler, I. and **Beling, P.**, “Polynomial Algorithms for Linear Programming over the Algebraic Numbers,” *Proceedings of the 24th Annual ACM Symposium on the Theory of Computing (STOC 1992)*, pp. 483–494, 1992.
59. Adler, I. and **Beling, P.**, “Polynomial Algorithms for LP over a Subring of the Algebraic Integers with Applications to LP with Circulant Matrices,” *Proceedings of the 32nd IEEE Symposium on Foundations of Computer Science (FOCS 1991)*, pp. 480–487, 1991.

Archival Conference Proceedings with Abstract-only Peer Review

1. Cestaro, J., Conklin, D., Ziman, D., Pan, E., Anhorn, G., Cunningham, M., Schulte, N., Dadgostari, F., and **Beling, P.**, “Optimization of Production and Packaging Schedules in a Mixed Discrete/Continuous Manufacturing Environment,” *Proceedings of the 2019 Systems and Information Engineering Design Symposium (SIEDS)*, pp. 1–6, 2019. Note: Underlined authors were undergraduates.
2. Roy, A., Sun, J., Mahoney, R., Alonzi, L., Adams, S., and **Beling, P.**, “Deep Learning Detecting Fraud in Credit Card Transactions,” *Proceedings of the 2018 Systems and Information Engineering Design Symposium (SIEDS)*, pp. 129–134, 2018. Note: Underlined authors were M.E. in Data Science students.
3. Cody, T., Adams, S., and **Beling, P.**, “A Utilitarian Approach to Adversarial Learning in Credit Card Fraud Detection,” *Proceedings of the 2018 Systems and Information Engineering Design Symposium (SIEDS)*, pp. 237–242, 2018. Note: Underlined author was an undergraduate student.
4. Mead, A., Lewis, T., Prasanth, S., Adams, S., Alonzi, P., and **Beling, P.**, “Detecting Fraud in Adversarial Environments: A Reinforcement Learning Approach,” *Proceedings of the 2018 Systems and Information Engineering Design Symposium (SIEDS)*, pp. 118–122, 2018. Note: Underlined authors were M.E. in Data Science students.
5. Rushin, G., Stancil, C., Sun, M., Adams, S., and **Beling, P.**, “Horse Race Analysis in Credit Card Fraud—Deep Learning, Logistic Regression, and Gradient Boosted Tree,” *Proceedings of the 2017 Systems and Information Engineering Design Symposium (SIEDS)*, pp. 117–121, 2017. Note: Underlined authors were M.E. in Data Science students.
6. Zeager, M., Sridhar, A., Fogal, N., Adams, S., Brown, D., and **Beling, P.**, “Adversarial Learning in Credit Card Fraud Detection,” *Proceedings of the 2017 Systems and Information Engineering Design Symposium (SIEDS)*, pp. 112–116, 2017. Note: Underlined authors were M.E. in Data Science students.

7. Kromkowski, A., Ferris, K., Montgomery, M., Saha, K., Wu, F., and **Beling, P.**, “Effect of Order Flow Imbalance on Market Impact Across Market States,” *Proceedings of the 2016 IEEE Systems and Information Engineering Design Symposium*, pp. 298-302, 2016. Note: Underlined authors were M.E. in Data Science students.
8. Bain, F., Ferris, K., Gregoire, J., Kim, J., Kozloski, J., Lazenby, J., Ofiesh, D., Shank, E., Wu, K., Fleming, C., and **Beling, P.**, “Risk Analysis of Globalized Airplane Supply Chains,” *Proceedings of the 2016 IEEE Systems and Information Engineering Design Symposium*, pp. 44–48, 2016. Note: Underlined authors were undergraduates.
9. Nettles, J., Brayer, N., Jenner, C., Ngo, A., Putnam, C., Shank, T., Todd, A., and **Beling, P.**, “Forecasting Intraday Volume Distributions,” *Proceedings of the 2015 IEEE Systems and Information Engineering Design Symposium*, pp. 97–102, 2015. Note: Underlined authors were undergraduates.
10. Han, W., Liu, X., Radcliffe, J., Ghariban, M., Wei, J., Chung, K., and **Beling, P.**, “Analysis of Manual Manufacturing Processes using Motion Sensing Technologies,” *Proceedings of the 2014 IEEE Systems and Information Engineering Design Symposium*, pp. 244–249, 2014. Note: Underlined authors were undergraduates.
11. Peruski, J., Lacy, C., Goethel, W., Boegner, M., Byers, J., Gorog, H., and **Beling, P.**, “Systemic Risk in the United States Banking Industry,” *Proceedings of the 2014 IEEE Systems and Information Engineering Design Symposium*, pp. 310–315, 2014. Note: Underlined authors were undergraduates.
12. Delpresto, J., Chuhong, D., Cho, K., Layiktez, L., Moju-Igbene, E., Wood, M., and **Beling, P.**, “Safe Lifting: An Adaptive Training System for Factory Workers Using the Microsoft Kinect”, *Proceedings of the 2013 IEEE Systems and Information Engineering Design Symposium*, 2013. Note: Underlined authors were undergraduates.
13. Martin, C., Burkert, D., Cho, K., Wieczorek, N., McGregor, P., Herrmann, R., and **Beling, P.**, “A Real-time Ergonomic Monitoring System using the Microsoft Kinect,” *Proceedings of the 2012 IEEE Systems and Information Engineering Design Symposium*, pp. 50–55, 2012. Note: Underlined authors were undergraduates.
14. Mayo, A., Bockneck, D., Blake, C., Rittenhouse, R., Boswell, B., **Beling, P.** and Wang, J., “Development of an Operator Interface for a Multi-Sensor Overhead Surveillance System,” *Proceedings of the 2011 IEEE Systems and Information Engineering Design Symposium*, pp. 215–220, 2011. Note: Underlined authors were undergraduates.
15. Hayes, R., Bao, J., **Beling, P.**, and Horowitz, B., “Use of Inverse Reinforcement Learning for Identity Prediction,” *2010 MODSIM World Conference*, NASA Langley Research Center, pp. 764–781, 2011.

16. Birisan, M. and **Beling, P.**, “Multi-Instance Learning Models for Automated Support of Analysts in Simulated Surveillance Environments,” *2010 MODSIM World Conference*, NASA Langley Research Center, pp. 30–47, 2011.
17. Reyes, I., Devore, M., **Beling, P.**, and Horowitz, B., “A Probability of Error-constrained Sequential Decision Algorithm for Data-Rich Automatic Target Recognition,” *Proceedings of SPIE*, **7696**, 769615, 2010.
18. Forte, M., Hummel, C., Morris, N., Pratsch, E., Shi, R., Bao, J. and **Beling, P.**, “Learning Human Behavioral Profiles in a Cyber Environment,” *Proceedings of the 2010 IEEE Systems and Information Engineering Design Symposium*, pp. 181–186, 2010. Note: Underlined authors were undergraduates.
19. Mo, K., **Beling, P.**, and Crowther, K., “Quantitative Assessment of Cyber Security Risk using a Bayesian Network-based Model,” *Proceedings of the 2009 IEEE Systems and Information Engineering Design Symposium*, 2009. Note: Underlined authors were undergraduates.
20. Cheng, K., Tumbokon, F., Sahu, R., and **Beling, P.**, “Track Based Characterization of Vehicle Behavior,” *Proceedings of the 2009 IEEE Systems and Information Engineering Design Symposium*, 2009. Note: Underlined authors were undergraduates.
21. Barry, M., Thevathasan, D., Yousif, T., and **Beling, P.**, “Scoring Models as a Tool for Teacher Self-Assessment,” *Proceedings of the 2009 IEEE Systems and Information Engineering Design Symposium*, pp. 101–106, 2009. Note: Underlined authors were undergraduates.
22. Wegner, S., Pascoe, A., Turner, R., Flesher, P., Negash, M., Meadows, S., Rains, E., **Beling, P.**, and Lark, J., “An Investigation of Log-Optimization and Stock Allocation Strategy on Large Cap U.S. Stocks,” *Proceedings of the 2008 IEEE Systems and Information Engineering Design Symposium*, pp. 16–22, 2008. Note: Underlined authors were undergraduates.
23. Flanagan, M., Noakes, P., Paulsen, L., Verley, B., Weightman, J., and **Beling, P.**, “Decentralized Coordination Processes”, *Proceedings of the 2006 IEEE Systems and Information Engineering Design Symposium*, pp. 1–5, 2006. Note: Underlined authors were undergraduates.
24. **Beling, P.**, Beaulieu, B., Durham, I., McKinstrie, R., Shumate, P., Stamper, K., and Verell, E., “Dynamic Multi-agent Coordination: Robocops”, *Proceedings of the 2005 IEEE Systems and Information Engineering Design Symposium*, pp. 386–392, 2005. Note: Underlined authors were undergraduates.

25. Chen, M. *et al.*, "Systems Analysis of Economic Impacts of Redeveloped Superfund", *Proceedings of the 2004 IEEE Systems and Information Engineering Design Symposium*, pp. 1–6, 2004. Note: Underlined authors were undergraduates.
26. Brinn, M., Fleming, J., Hannaka, F., Thomas, C., and **Beling, P.**, "Investigation of Forward Citation Count as a Patent Analysis Method", *Proceedings of the 2003 IEEE Systems and Information Engineering Design Symposium*, pp. 1-6, 2003. Note: Underlined authors were undergraduates.
27. Dumrong, P., Gould, J., Lee, G., Nicholson, L., Gao, L., and **Beling, P.**, "The Quantification of Unstructured Information and its use in Predictive Modeling", *Proceedings of the 2003 IEEE Systems and Information Engineering Design Symposium*, pp. 225-232, 2003. Note: Underlined authors were undergraduates.
28. S. Pelletier, J. Lyman, J. Dalton, S. Tropello, B. Dembling, K. Scully, J. Boyd, **P. Beling**, S. Guerlain, E. Bass, W. Knaus, D. Brown, "Design approach for a database system integrating and interpreting demographic, clinical and biological data," *American Journal of Human Genetics*, **71** (4), pp. 375–375, Meeting Abstract, 2002.
29. Arkali, C. *et al.*, "Multi-objective Scoring Strategies Tool," *Proceedings of the 2002 IEEE Systems and Information Engineering Design Symposium*, pp. 19–24, 2002. Note: Underlined authors were undergraduates.
30. Mullei, S. and **Beling, P.**, "Evolution of Rule-induced Scoring Functions for Stock Selection," *Proceedings of the 1998 IMACS/IEEE Conference on Computational Engineering in Systems Applications*, pp. 36–41, 1998.
31. Long, P. and **Beling, P.**, "Hybrid Interior Point-Simplex Algorithms for Linear Programming," *Proceedings of the 1998 IMACS/IEEE Conference on Computational Engineering in Systems Applications*, pp. 52–58, 1998.
32. **Beling, P.** and Tran, L., "A Surrogate Cost Method for Hierarchical Network Design," *Proceedings of the 1998 IMACS/IEEE Conference on Computational Engineering in Systems Applications*, pp. 42–47, 1998.
33. Tran, L. and **Beling, P.**, "Aggregation Heuristics for the Access Area Problem", *Proceedings of the 1998 IASTED Conference on Modeling and Simulation*, pp. 434–438, 1998.
34. Lankford, C., Shannon, P., **Beling, P.**, McLaughlin, P., Israelski, E., Ellis, S., and Hutchinson, T., "Graphical User Interface Design Using Eye Gaze Tracking and Pupil Response with ERICA," *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, p. 1371, 1997.

Books

1. *Systems Engineering in Context*, Adams, S., **Beling, P.**, Lambert, J., Scherer, W., and Fleming, C., eds., Springer Nature, 2019.

Book Chapters

1. Adams, S., Scherer, W., and **Beling, P.** “Data, Insights, Models, and Decisions: Machine Learning in Context,” in *Intuition, Trust, and Analytics*, Leibowitz, J., Paliszkievicz, J., and Gotuchowski, J., eds., CRC Press, pp. 213–230, 2017.
2. **Beling, P.**, Lambert, J., Rahman, F., Overstreet, G., and Slutzky, D., “Systems Analysis and Adaptive Learning for Portfolio Management of Superfund Sites,” in *Reclaiming the Land: Rethinking Superfund Institutions, Methods and Practices*, Macey, G. and Cannon, J., eds., Springer, pp. 129–168, 2007.
3. Verma, S., **Beling, P.**, and Adler, I., “A New Parameterization Algorithm for the Linear Complementarity Problem,” in *Approximation and Complexity in Numerical Optimization: Continuous and Discrete Problems*, Pardalos, P., ed., Kluwer, pp. 545–560 2000.

Patents

1. Crannell G., Beling P., Choo B., Landau M., Adams S., Bolcavage A., McIntyre R., inventors; Rolls-Royce PLC, Rolls-Royce Corp, University of Virginia, assignee. "Automated Visual Inspection System". United States patent application US 15/644,559, 2019.

Authorship on Major Published Reports

1. “Information Science at the Army Research Laboratory,” National Academies/National Research Council, 2019.
2. “Information Science at the Army Research Office,” National Academies/National Research Council, 2018.
3. “Information Science at the Army Research Laboratory,” National Academies/National Research Council, 2018.
4. “Information Science at the Army Research Laboratory,” National Academies/National Research Council, 2016.
5. “Information Science at the Army Research Laboratory,” National Academies/National Research Council, 2015.

6. "Improving the Decision Making Abilities of Small Unit Leaders," Committee on Improving the Decision Making Abilities of Small Unit Leaders; Naval Studies Board; Division on Engineering and Physical Sciences; National Research Council, 2012.

Conference Presentations without an Associated Paper³

1. **Beling, P.**, Langevin, A., and Adams, S., "Credit Card Fraud Detection using Privacy-Preserving Distributed Deep Learning and Synthetic Dataset Creation", Credit Scoring and Credit Control XVI, Edinburgh, UK, 2019.
2. **Beling, P.**, Fleming, C., Elks, C., and Horowitz, B., "Mission-Aware Cybersecurity: Cyber Body of Knowledge," Military Operations Research Workshop on Cyber Modeling and Games, McLean, VA, 2018.
3. Fleming, C., **Beling, P.**, Elks, C., Horowitz, B., and Lucero, S., "Mission-Aware Cybersecurity," National Defense Industry Association System Security Engineering Symposium, Washington, DC, 2016.
4. Adams, S. and **Beling, P.**, "Cost and Machine Learning: An Application to Feature Selection for Hidden Markov Models," 2015 Conference of the Center of Excellence in Wireless and Information Technology at Stony Brook University (CEWIT 2015).
5. Pira da Cruz, J., Rajaratnam, K., **Beling, P.**, and Overstreet, G., "Sand Pile Modeling for Machine Learning Algorithms for Economic/Financial Applications," Credit Scoring and Credit Control XIV, Edinburgh, UK, 2015.
6. Rajaratnam, K., **Beling, P.**, and Overstreet, G., "Consumer Loan Scoring and Regulatory Capital Decisions in the Context of Uncertain Economic Conditions," Computational Management Science, Prague, Czech Republic, 2015.
7. Pira da Cruz, J., Rajaratnam, K., **Beling, P.**, and Overstreet, G., "Sand Pile Modeling for Machine Learning Algorithms for Economic/Financial Applications," Computational Management Science, Prague, Czech Republic, 2015.
8. **Beling, P.**, Patek, S. Zhao, Y., "Multi-agent Coordination in Team Search Problems under a Bayesian Framework," INFORMS Annual Meeting 2014, San Francisco, CA 2014.
9. Todd, A., **Beling, P.**, Burkett, M., Hayes, R., Scherer, W., "Agent-based Models of Microstructure for Order-driven Markets," INFORMS Annual Meeting 2014, San Francisco, CA 2014.
10. Rajaratnam, K., **Beling, P.**, Overstreet, G., and Qiao, Q., "Consumer Loans Acquisition Decision Under Adverse Selection: A Sequential Decision Modeling Approach", Credit Scoring and Credit Control XIII, Edinburgh, UK, 2013.

³The speaker is listed first.

11. Sanderford, A., Overstreet, G., Rajaratnam, K., and **Beling, P.**, "Implications for Energy Efficient Housing Trends on the Assessment of Mortgage Risk", Credit Scoring and Credit Control XIII, Edinburgh, UK, 2013.
12. M. Paddrik, M. Burkett, W. Scherer, and **P. Beling**, "Monitoring Financial Market Behavior through a Markov Model," INFORMS Annual Meeting 2013, Minneapolis, MN, 2013.
13. Rubin, J., Rajaratnam, K., Overstreet, G., and **Beling, P.**, "A Dynamic Theory of the Credit Union", Credit Scoring and Credit Control XI, Edinburgh, UK, 2009.
14. Rajaratnam, K., **Beling, P.**, and Overstreet, G., "Scoring Decisions in the Context of Economic Uncertainty", INFORMS National Meeting, Seattle, WA, 2007.
15. **Beling, P.**, Rajaratnam, K., and Overstreet, G., "Contributions toward a Theoretical Framework for the Efficient use of Multiple Scorecards", Credit Scoring and Credit Control X, Edinburgh, UK, 2007.
16. **Beling, P.**, Jiang, W., Oliver, R., and Overstreet, G., "Misstatement of Regulatory Capital Requirements: Some Implications for Retail Banking Profits," Credit Scoring and Credit Control IX, Edinburgh, UK, 2005.
17. Gao, L. and **Beling, P.**, "Modeling the Origination Decision for Installment Loans", Credit Scoring and Credit Control VIII, Edinburgh, UK, 2003.
18. **Beling, P.**, Covaliu, Z., and Oliver, R., "Dominant Score Cutoff Strategies", Credit Scoring and Credit Control VII, Edinburgh, UK, 2001.
19. **Beling, P.**, Zhu, H., and Overstreet, G., "Bayesian Methods for the Combination of Credit Scores", Joint Statistical Meeting of the American Statistical Association, Indianapolis, IN, 2000.
20. Zhu, H., **Beling, P.**, and Overstreet, G., "A Bayesian Framework for Classifier Combination", Credit Scoring and Credit Control VI, Edinburgh, UK, 1999.
21. Zhu, H., **Beling, P.**, and Overstreet, G., "A Study in the Combination of Consumer Credit Scores", Credit Scoring and Credit Control VI, Edinburgh, UK, 1999.
22. Willis, J. and **Beling, P.**, "Optimization of Credit Union Membership Portfolios", INFORMS National Meeting, Cincinnati, OH, 1999.
23. **Beling, P.** and Zhu, H., "A Study in the Combination of Two Credit Scores", INFORMS National Meeting, Cincinnati, OH, 1999.
24. **Beling, P.**, Verma, S., and Adler, I., "An Algorithm for the Linear Complementarity Problem that is Competitive with Lemke's Method on Average", University of Florida, Center for Applied Optimization, Conference on Approximation and Complexity in Numerical Optimization", Gainesville, FL, 1999.

25. Adler, I., **Beling, P.**, and Verma, S., "A New Matrix Parameterization Algorithm for the Linear Complementarity Problem", 16th International Symposium on Mathematical Programming, Lucerne, Switzerland, 1997.
26. Mullei, S., and **Beling, P.**, "Induced Scoring Models for a Multi-Criteria Stock Selection Process", 14th International Conference on Multiple Criteria Decision Making, Charlottesville, VA, June 1998.
27. **Beling, P.**, Rossetti, M., and Strickland, S., "A System Requirements Prototype for a World Wide Web Learning Environment", INFORMS National Meeting, Atlanta, GA, 1996.
28. **Beling, P.**, Brown, D., and Chalasani, V., "Linear Programming-based Classifiers for Multi-modal Data", INFORMS National Meeting, Atlanta, GA, 1996.
29. **Beling, P.**, Long, P., and Mayer, M., "Hybrid Interior Point-Simplex Algorithms in a Distributed Computing Environment", INFORMS National Meeting, Atlanta, GA, 1996.
30. **Beling, P.**, Tran, L., and White, D., "Aggregation Methods for a Telecommunications Network Design Problem", INFORMS National Meeting, Atlanta, GA, 1996.
31. **Beling, P.** and Adler, I., "Strongly Polynomial Algorithms for Certain Patterned Linear Programs", 15th International Symposium on Mathematical Programming, Ann Arbor, MI, 1994.
32. **Beling, P.** and Adler, I., "Probabilistic Results for Linear Programming Algorithms with Exponential Worst-case Complexity", ORSA/TIMS Joint National Meeting, Phoenix, AZ, 1993.
33. **Beling, P.** and Adler, I., "Strongly Polynomial Algorithms for a Class of Linear Programs with Patterned Coefficient Matrices", ORSA/TIMS Joint National Meeting, San Francisco, CA, 1992. Also: VIth CLAIO Conference, Mexico City, 1992.
34. **Beling, P.**, and Adler, I., "Polynomial Algorithms for Linear Programming over the Algebraic Numbers", VIth CLAIO Conference, Mexico City, 1992. Also: 14th International Symposium on Mathematical Programming, Amsterdam, 1991.
35. **Beling, P.** and Adler, I., "Rational Arithmetic in Linear Programming over the Algebraic Numbers", Sixth Advanced Research Institute on Discrete Applied Mathematics, Rutgers Center for Operations Research, New Brunswick, NJ, 1991.
36. **Beling, P.** and Adler, I., "Polynomial Algorithms for LP over a Subring of the Algebraic Integers with Applications to LP with Circulant Matrices", ORSA/TIMS Joint National Meeting, Anaheim, CA 1991. Also: Sixth Advanced Research Institute on Discrete Applied Mathematics, Rutgers Center for Operations Research, New Brunswick, NJ, 1991.

37. Adler, I. and **Beling, P.**, "Strongly Polynomial Algorithms for Circulant Linear Programs", SIAM Conference on Complexity Issues in Numerical Optimization, Ithaca, NY, 1991.

Invited Talks⁴

1. "A Systems Theoretic Perspective on Transfer Learning", The 15th International Conference on Emerging Technologies for a Smarter World (CEWIT 2019), Stony Brook University, Stony Brook, NY, 2019.
2. "Decision Support Tools for Architectural Design of Cyber Resilient Systems," Department of Defense Systems Engineering Research Center (SERC) Annual Meeting, Washington, DC, 2018.
3. "Decision Informatics at the University of Virginia," Center for Visual and Decision Informatics Advisory Board Meeting, University of Louisiana, Lafayette, LA, 2018.
4. "Reinforcement Learning-based Decision Informatics," The 13th International Conference on Emerging Technologies for a Smarter World (CEWIT 2017), Stony Brook University, Stony Brook, NY, 2017.
5. "Decision Informatics at the University of Virginia," Center for Visual and Decision Informatics Advisory Board Meeting, University of Virginia, Charlottesville, VA, 2017.
6. "Security Engineering – FY16 System-Aware Cybersecurity," Department of Defense Systems Engineering Research Center (SERC) Annual Meeting, Washington, DC, 2016.
7. "Security Engineering – FY16 System-Aware Cybersecurity," Department of Defense Systems Engineering Research Center (SERC) Annual Meeting, Washington, DC, 2016.
8. "Security Engineering – FY16 System-Aware Cybersecurity," Department of Defense Systems Engineering Research Center (SERC) Annual Meeting, Washington, DC, 2016.
9. "Case Studies in Industry-University Research on Big Data for Internet of Things," Center for Visual and Decision Informatics Advisory Board Meeting, Lafayette, LA, 2016.
10. "Human Factors in Engineering – The Management / University Collaboration Perspective," Chartered Institute of Ergonomics and Human Factors, Cranfield University, UK, 2016.
11. "Methodology for Anticipating and Responding to Successful Cyber Attacks on Cyber Physical Systems," Defense Modeling & Simulation Coordination Office Sub Group on Cyber Threat Modeling, Alexandria, VA, 2016.

⁴In all cases Peter Beling was the speaker.

12. "Dynamic Data Analytics at the University of Virginia," Center for Dynamic Data Analytics Semi-annual Meeting, Stony Brook University, 2015.
13. "Model-Based Decision Support for Systems-Aware Cybersecurity," Department of Defense Systems Engineering Research Center (SERC) Annual Meeting, Georgetown University, 2014.
14. "Dynamic Data Analytics at the University of Virginia," Center for Dynamic Data Analytics Semi-annual Meeting, Rutgers University, 2014.
15. "Dynamic Sensemaking and Prediction in Finance," Center for Dynamic Data Analytics Semi-annual Meeting, Stony Brook University, 2014.
16. "Recognition of Agents based on Observation of their Sequential Behavior," Office of Financial Research, Washington, D.C., 2014.
17. "Automated Understanding of Human Activity in Manufacturing Settings," NAE Symposium on Challenges of Advanced Manufacturing, Charlottesville, VA 2014.
18. "Opportunities for Corporate Behavioral Modeling," in Financial Services and Investment Innovation through XBRL panel session, XBRL Research Workshop, Stevens Institute of Technology, 2013.
19. "CCAM Human Characterization and Knowledge Capture Research," Aerojet Ordnance, Johnson City, TN, 2012.
20. "Object Tracking and Human Activity Recognition on the Factory Floor using Microsoft Kinect and other Commodity Sensors," GE Intelligent Platforms, Charlottesville, VA, 2012.
21. "Characterization of Human Performance using Continuous Motion Data," Newport News Shipbuilding, Newport News, VA, 2011.
22. "Characterization of Human Performance using Continuous Motion Data," Virginia State University, 2011.
23. "Identify Prediction using Inverse Reinforcement Learning," Human Effectiveness Directorate, Air Force Research Laboratory, 2009.
24. "Random Shape Representations for 3D ATR," Air Force Research Laboratory ATR Center Workshop, Wright State University, 2008.
25. "ATR from a Systems Engineering Viewpoint," Air Force Research Laboratory ATR Center Workshop, Wright State University, 2008.
26. "Image Processing Architecture in Support of Mobile Users with Limited Support Technology, Accenture, Inc., Chicago, IL, 2007.

27. “Economic Contingency Models for Reuse of Superfund Sites,” Workshop on Interdisciplinary Approaches to Transforming Contaminated Sites, Charlottesville, VA, 2004. (with James Lambert)
28. “Open Research Questions in Consumer Credit Modeling,” Banff Credit Risk Conference, Banff International Research Station, 2003.
29. “Optimization-based Decision Tree Classifiers,” Department of Mechanical, Industrial, and Nuclear Engineering, University of Cincinnati, 1999.
30. “Topological Design of Communication Networks,” Department of Mathematics, College of William and Mary, 1997.

EXTERNAL RESEARCH GRANTS AND CONTRACTS

Sponsored Research Projects

1. *Developmental Test and Evaluation (DT&E) and Cyberattack Resilient Systems*
 Sponsor: Department of Defense (Systems Engineering Research Center)
 Research Period: October 2019 to January 2021
 Principal Investigator: C. Fleming
 Co-PI(s): **P. Beling** and B. Horowitz
 Amount Requested: \$750,000
 P. Beling’s Share: 40%
2. *Machine Learning Algorithms for Cyber Sentinel Detection, State Estimation, and Forensics*
 Sponsor: Mission Secure Incorporated
 Research Period: June 2019 to May 2021
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount Requested: \$450,000
 P. Beling’s Share: 100%
3. *Security Engineering (2019)*
 Sponsor: Department of Defense (Systems Engineering Research Center)
 Research Period: June 2019 to June 2019
 Principal Investigator: **P. Beling**
 Co-PI(s): B. Horowitz, C. Fleming
 Amount Requested: \$452,000
 P. Beling’s Share: 50%

4. *Risk-Based Approach to Cyber Vulnerability Assessment*
 - Sponsor: Department of Defense (Systems Engineering Research Center)
 - Research Period: May 2019 to April 2020
 - Principal Investigator: **P. Beling**
 - Co-PI(s): B. Horowitz, C. Fleming
 - Amount Requested: \$224,000
 - P. Beling's Share: 50%

5. *Security Engineering (2018)*
 - Sponsor: Department of Defense (Systems Engineering Research Center)
 - Research Period: February 2018 to December 2018
 - Principal Investigator: **P. Beling**
 - Co-PI(s): B. Horowitz, C. Fleming
 - Amount Requested: \$323,000
 - P. Beling's Share: 50%

6. *Wireless, Intelligent, Non-Invasive, Low-Power Life-Cycle Status Monitoring Systems for Efficient Armaments Inspection and Sustainment*
 - Sponsor: Luna Innovations
 - Research Period: January 2018 to January 2019
 - Principal Investigator: **P. Beling**
 - Co-PI(s): S. Adams
 - Award Amount: \$80,000
 - P. Beling's Share: 100%

7. *I/UCRC: Center for Visual and Decision Informatics (CVDI) Site at the University of Virginia*
 - Sponsor: National Science Foundation
 - Research Period: March 2017 to February 2022
 - Principal Investigator: **P. Beling**
 - Co-PI(s): W. Scherer, D. Brown, M. Gerber, H. Wang
 - Award Amount: \$500,000 plus funding from planned projects
(subject to final budget approval as noted in attached NSF email)
 - P. Beling's Share: 100%

8. *Algorithms for Condition Monitoring and Prognostics at the Sensor Node, Phase II*
 - Sponsor: Luna Technologies (subcontract from Navy SBIR)
 - Research Period: March 2017 to December 2020
 - Principal Investigator: **P. Beling**
 - Co-PI(s): none
 - Amount of Award: \$210,000
 - P. Beling's Share: 100%

9. *Security Engineering (2017)*

- Sponsor: Department of Defense (Systems Engineering Research Center)
 Research Period: January 2017 to December 2017
 Principal Investigator: B. Horowitz
 Co-PI(s): **P. Beling**, C. Fleming
 Amount of Award: \$350,000
 P. Beling's Share: 36%
10. *Prognostics & Health Monitoring of MHK Devices, Phase II*
 Sponsor: Luna Technologies (subcontract from Department of Energy SBIR)
 Research Period: January 2017 to August 2018
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$120,000
 P. Beling's Share: 100%
11. *Security Engineering (2016)*
 Sponsor: Department of Defense (Systems Engineering Research Center)
 Research Period: January 2016 to October 2016
 Principal Investigator: B. Horowitz
 Co-PI(s): **P. Beling**
 Amount of Award: \$398,000
 P. Beling's Share: 26%
12. *Development of Online System for Building Learning Models*
 Sponsor: Commonwealth Center for Advanced Manufacturing
 Research Period: September 2015 to March 2016
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$110,345
 P. Beling's Share: 100%
13. *Planning Grant: I/UCRC for Center for Visual and Decision Informatics Site at the University of Virginia*
 Sponsor: National Science Foundation
 Research Period: September 2015 to August 2016
 Principal Investigator: **P. Beling**
 Co-PI(s): W. Scherer, A. Shelat
 Amount of Award: \$14,740
 P. Beling's Share: 100%
14. *Algorithms for Condition Monitoring and Prognostics at the Sensor Node*

- Sponsor: Luna Technologies (subcontract from Navy SBIR)
 Research Period: August 2015 to August 2016
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$30,000
 P. Beling's Share: 100%
15. *Prognostics & Health Monitoring of MHK Devices*
 Sponsor: Luna Technologies (subcontract from Department of Energy SBIR)
 Research Period: August 2015 to August 2016
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$30,000
 P. Beling's Share: 100%
16. *Security Engineering (2015)*
 Sponsor: Department of Defense (Systems Engineering Research Center)
 Research Period: January 2015 to December 2015
 Principal Investigator: B. Horowitz
 Co-PI(s): **P. Beling**
 Amount of Award: \$579,000
 P. Beling's Share: 26%
17. *Methodologies for Real-Time Diagnostics and Prognostics and for Cyber Security in Smart Manufacturing Systems*
 Sponsor: National Institute of Standards (NIST)
 Research Period: August 2014 to January 2017
 Principal Investigator: **P. Beling**
 Co-PI(s): Y. Haimes, B. Horowitz
 Amount of Award: \$400,000
 P. Beling's Share: 40%
18. *Statistical Modeling of Human Factors in Thermal Spray*
 Sponsor: Rolls Royce
 Research Period: August 2014 to December 2018
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$675,000 (awarded in semi-annual and annual contracts)
 P. Beling's Share: 100%
19. *Chip Characterization using Statistical Learning*

- Sponsor: Commonwealth Center for Advanced Manufacturing
 Research Period: February 2014 to September 2014
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$84,917
 P. Beling's Share: 100%
20. *Security Engineering (2014)*
 Sponsor: Department of Defense (Systems Engineering Research Center)
 Research Period: January 2014 to December 2014
 Principal Investigator: B. Horowitz
 Co-PI(s): **P. Beling**, K. Skadron, R. Williams
 Amount of Award: \$617,000
 P. Beling's Share: 20%
21. *Feature Generation using Inverse Learning*
 Sponsor: National Science Foundation (BWAC I/UCRC)
 Research Period: September 2013 to September 2014
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$34,000
 P. Beling's Share: 100%
22. *I/UCRC: Broadband Wireless Access & Applications Center (BWAC)*
 Sponsor: National Science Foundation
 Research Period: September 2013 to August 2018
 Principal Investigator: B. Horowitz
 Co-PI(s): S. Patek, **P. Beling**, R. Cogill, A. Garcia
 Amount of Award: \$300,000 plus funding from planned projects
 P. Beling's Share: 0% (support listed on an individual project basis)
23. *Blade Wall Thickness Measurement & Process Improvement*
 Sponsor: Commonwealth Center for Advanced Manufacturing
 Research Period: May 2013 to January 2015
 Principal Investigator: S. Agnew
 Co-PI(s): **P. Beling**
 Amount of Award: \$237,000
 P. Beling's Share: 15%
24. *2013 Continuation – Human Factors – Characterization of Human Performance using Continuous Motion Data*

- Sponsor: Commonwealth Center for Advanced Manufacturing
 Research Period: March 2013 to March 2014
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$160,000
 P. Beling's Share: 100%
25. *Multi-agent Inverse Reinforcement Learning: Framework, Algorithms and Applications (Scholarship for Xiaomin Lin)*
 Sponsor: SAIC, Inc., Research Scholars Program
 Research Period: September 2012 to September 2013
 Principal Investigator: **P. Beling**
 Co-PI(s): R. Cogill
 Amount of Award: \$20,000 (scholarship support for student)
 P. Beling's Share: 50%
26. *Pairing Task Models and HMM Classifiers for the Automatic Detection and Tracking of Human Activity (Scholarship for Don Rude)*
 Sponsor: SAIC, Inc., Research Scholars Program
 Research Period: September 2012 to September 2013
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$20,000 (scholarship support for student)
 P. Beling's Share: 100%
27. *Research Experience for Undergraduates (REU) in Support of WICAT I/UCRC*
 Sponsor: National Science Foundation
 Research Period: April 2012 to April 2013
 Principal Investigator: B. Horowitz
 Co-PI(s): **P. Beling**
 Amount of Award: \$16,000
 P. Beling's Share: 50%
28. *Human Factors – Characterization of Human Performance using Continuous Motion Data*
 Sponsor: Commonwealth Center for Advanced Manufacturing
 Research Period: January 2012 to January 2013
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$172,000
 P. Beling's Share: 100%
29. *Security Engineering (2012)*

- Sponsor: Department of Defense (Systems Engineering Research Center)
 Research Period: January 2012 to December 2012
 Principal Investigator: B. Horowitz
 Co-PI(s): **P. Beling**, K. Skadron, R. Williams
 Amount of Award: \$755,642
 P. Beling's Share: 17%
30. *Collaborative Research: Fundamental Research on Adaptive Wireless Video Systems*
 Sponsor: National Science Foundation
 Research Period: July 2011 to August 2013
 Principal Investigator: **P. Beling**
 Co-PI(s): B. Horowitz
 Amount of Award: \$50,000
 P. Beling's Share: 90%
31. *Development of an Instructional Module on Modeling and Optimization*
 Sponsor: Sub-account through SIE Department's National
 Library of Medicine training grant
 Research Period: March 2011 to December 2011
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Budget: \$20,000
 P. Beling's Share: 100%
32. *Security Engineering (2011)*
 Sponsor: Department of Defense (Systems Engineering Research Center)
 Research Period: January 2011 to December 2011
 Principal Investigator: B. Horowitz
 Co-PI(s): **P. Beling**, R. Williams
 Amount of Award: \$381,609
 P. Beling's Share: 21%
33. *Computational Investigation of Model-based Algorithms for LADAR ATR (Scholarship for Irwin Reyes)*
 Sponsor: SAIC, Inc., Research Scholars Program
 Research Period: January 2011 to December 2011
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$20,000 (scholarship support for student)
 P. Beling's Share: 100%
34. *Improving Operator Effectiveness, Information Collection, and Scenario Characterization through the use of Multi- Instance Learning (Scholarship for Mihnea Birisan)*

- Sponsor: SAIC, Inc.
 Research Period: January 2010 to December 2010
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$20,000 (scholarship support for student)
 P. Beling's Share: 100%
35. *Graduate Research Supplement to NSF grant No. EEC-0827153, a IJTechnology-based Evaluation of Classroom Learning*
 Sponsor: National Science Foundation
 Research Period: September 2009 to September 2011
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$38,000
 P. Beling's Share: 100%
36. *Technology-Based Evaluation of Classroom Learning*
 Sponsor: National Science Foundation
 Research Period: September 2008 to September 2011
 Principal Investigator: **P. Beling**
 Co-PI(s): B. Horowitz; R. Pianta & J. Downer (Curry School)
 Amount of Award: \$487,000
 P. Beling's Share: 60%
37. *Characterization of Collections of Vehicle Tracks*
 Sponsor: National Science Foundation (WICAT I/UCRC)
 Research Period: September 2008 to September 2009
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$34,000
 Academic Year Support: none
38. *Fundamental Research on Video Streaming for Technology-Based Classroom Learning Evaluation*
 Sponsor: National Science Foundation
 Research Period: July 2008 to July 2010
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$100,000
 P. Beling's Share: 100%
39. *Incentives for Better Cyber Security through More Accurate, Transparent Pricing of Risk*

- Sponsor: The Institute for Information Infrastructure Protection
 Research Period: March 2008 to March 2009
 Principal Investigator: Y. Haimes
 Co-PI(s): **P. Beling**, K. Crowther, B. Horowitz
 Amount of Award: \$300,000
 P. Beling's Share: 20 %
40. *Tracking and Classification Services for Mobile Information Processing Architecture*
 Sponsor: National Science Foundation (WICAT I/UCRC)
 Research Period: March 2008 to March 2009
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$80,000
 P. Beling's Share: 100%
41. *Video Compression, Camera Control, and Networking in a Space and Bandwidth Constrained Environment*
 Sponsor: National Science Foundation (WICAT I/UCRC)
 Research Period: September 2007 to September 2009
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$176,000
 P. Beling's Share: 100%
42. *Automatic Extraction of Metadata from Video*
 Sponsor: National Science Foundation (WICAT I/UCRC)
 Research Period: September 2007 to September 2008
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$34,000
 P. Beling's Share: 100%
43. *Wireless Sensor Networks for Biometric Detection*
 Sponsor: National Science Foundation
 Research Period: August 2007 to August 2009
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$45,000
 P. Beling's Share: 100%
44. *Random Shape and Reflectance Representations for 3-D Assisted/Automated Target Recognition*

- Sponsor: Air Force Research Laboratory
 Research Period: August 2007 to January 2010
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$150,000
 P. Beling's Share: 100%
45. *Dynamic Coordination for Distributed Planning with Limited Communication*
 Sponsor: National Science Foundation
 Research Period: July 2004 to July 2008
 Principal Investigator: S. Patek
 Co-PI(s): **P. Beling**, A. Garcia
 Amount of Award: \$414,700
 P. Beling's Share: 20 %
46. *Solution Concepts for Static Coordination Problems*
 Sponsor: NASA LaRC
 Research Period: June 2004 to December 2005
 Principal Investigator: **P. Beling**
 Co-PI(s): S. Patek, A. Garcia
 Amount of Award: \$125,000
 P. Beling's Share: 80 %
47. *Solution Concepts for Distributed Decision-Making without Coordination*
 Sponsor: NASA LaRC
 Research Period: May 2003 to December 2003
 Principal Investigator: **P. Beling**
 Co-PI(s): S. Patek
 Amount of Award: \$54,000
 P. Beling's Share: 100%
48. *Multiobjective Optimization Models for Superfund for Site Recycling*
 Sponsor: Environmental Protection Agency
 Research Period: June 2002 to May 2004
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$66,000
 P. Beling's Share: 100%
49. *Routing and Scheduling Algorithms for Magnetic Levitation Transport Systems*

- Sponsor: Federal Railway Administration
 Research Period: August 2001 to August 2002
 Principal Investigator: T. Giras
 Co-PI(s): **P. Beling** , D. Brown
 Amount of Award: \$150,000
 P. Beling's Share: 25%
50. *Design of a Rule-based Financial Advising System*
 Sponsor: First Union National Bank, Charlotte, NC
 Research Period: September 2000 to September 2001
 Principal Investigator: C. Mastrangelo
 Co-PI(s): **P. Beling**
 Amount of Award: \$28,000
 P. Beling's Share: 50%
51. *Decision Environments for the Valuation of Intellectual Property*
 Sponsor: Mosaic Collateral Asset Management, Inc.
 Research Period: November 1999 to November 2003
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$150,000
 P. Beling's Share: 100%
52. *Analysis of Web Systems for MRO Procurement*
 Sponsor: American Management Systems, Inc.
 Research Period: September 1999 to August 2000
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$10,000
 P. Beling's Share: 100%
53. *Experimental Evaluation of the Virtual Factory Teaching System*
 Sponsor: National Science Foundation
 (subcontract through University of Southern California)
 Research Period: June 1999 to May 2001
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$22,116
 P. Beling's Share: 100%
54. *Collateral Evaluation Scoring System*

- Sponsor: Virginia's Center for Innovative Technology
 Research Period: December 1998 to December 1999
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$30,000
 P. Beling's Share: 100%
55. *Mobile Banking and Loan Processing Environments*
 Sponsor: American Management Systems, Inc.
 Research Period: September 1998 to August 1999
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$20,000
 P. Beling's Share: 100%
56. *Information Tools for Online Prediction*
 Sponsor: Fair, Isaac and Company, Inc.
 Research Period: May 1997 to May 1999
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$131,000
 P. Beling's Share: 100%
57. *Center for Mobile Information Technology: Research Center Feasibility Study*
 Sponsor: Virginia's Center for Innovative Technology
 Research Period: May 1997 to August 1998
 Principal Investigator: **P. Beling**
 Co-PI(s): D. Brown, J. Liebeherr, M. Mayer, M. Rossetti
 W. Scherer, R. Spekman
 Amount of Award: \$25,000
 P. Beling's Share: 100%
58. *World Wide Web-based Credit Evaluation Systems*
 Sponsor: Fair, Isaac and Company, Inc.
 Research Period: October 1996 to August 1997
 Principal Investigator: **P. Beling**
 Co-PI(s): none
 Amount of Award: \$45,000
 P. Beling's Share: 100%
59. *Risk-based Sustainable Policy for Distributed Flood Protection*

Sponsor: National Science Foundation
 Research Period: September 1995 to September 1998
 Principal Investigator: Y. Haimés
 Co-PI(s): **P. Beling**, B. Johnson, J. Lambert
 Amount of Award: \$285,000
 P. Beling's Share: 15%

60. *Vision Virginia*

Sponsor: Virginia Telephone Association
 Research Period: October 1994 to March 1995
 Principal Investigator: Y. Haimés
 Co-PI(s): **P. Beling**, J. Lambert
 Amount of Award: \$173,000
 P. Beling's Share: 5%

Donations in Support of Research

1. *Research Related to the Evaluation and Optimization of Long-term Investment Strategies*
 Donor: IPTech, Inc.
 Date: September 2007
 Principal Beneficiary: **P. Beling**/Financial Engineering Research Group
 Amount: \$45,000
2. *Research Related to Incorporating Economic Forecasts in Credit Portfolio Decisions*
 Donor: Fair Isaac and Company, Inc.
 Date: May 2006
 Principal Beneficiary: **P. Beling**/Financial Engineering Research Group
 Amount: \$20,000
3. *Research Related to Probabilistic Modeling of Installment Loan Origination Decisions*
 Donor: Fair Isaac and Company, Inc.
 Date: July 2002
 Principal Beneficiary: **P. Beling**/Financial Engineering Research Group
 Amount: \$25,000
4. *Research Related to Predictive Modeling using Unstructured Information*
 Donor: Fair Isaac and Company, Inc.
 Date: September 2002
 Principal Beneficiary: **P. Beling**/Financial Engineering Research Group
 Amount: \$20,000
5. *Research Related to Data Visualization Tools for Credit Portfolio Management*

- Donor: Fair Isaac and Company, Inc.
 Date: August 2001
 Principal Beneficiary: **P. Beling**/Financial Engineering Research Group
 Amount: \$15,000
6. *Research Related to Bayesian Methods for Discrete Score Combination*
 Donor: Fair Isaac and Company, Inc.
 Date: August 2000
 Principal Beneficiary: **P. Beling**/Financial Engineering Research Group
 Amount of Award: \$90,000
7. *Research Related to Computer Telephony Integration for Financial Information Reporting and Analysis*
 Donor: SNL Securities, Inc.
 Date: September 1998
 Principal Beneficiary: **P. Beling**/Financial Engineering Research Group
 Amount: \$15,000
8. *Research Related to Optimal Collections Systems for Credit Card Debt*
 Donor: Partners First, Boston, MA
 Date: September 1998
 Principal Beneficiary: **P. Beling**/Financial Engineering Research Group
 Amount: \$20,000

Major In-Kind Gifts in Support of Research

1. *Infrastructure to Support Adaptive Wireless Video Systems*
 Sponsor: Cisco Systems, Inc.
 Research Period: March 2011 to March 2014
 Principal Beneficiaries: **P. Beling**, B. Horowitz
 Description of Gift: \$345,000 in cameras and video servers
 P. Beling's Portion of Gift: 75%
2. *SNL DataSource*
 Donor: SNL Securities, Charlottesville, VA
 Date: August 1999
 Principal Beneficiaries: **P. Beling**/Financial Engineering Research Group
 and R. Smith/McIntire School of Commerce
 Description of Gift: Data services & software; tax valuation of \$1,161,566
 P. Beling's Portion of Gift: 50%
3. *Collaborative Learning Environments, Pervasive Computing Applications, and Enabling Technologies for E-business*

Donor: IBM
Date: June 1999
Principal Beneficiaries: **P. Beling** & M. Rosen/ SEAS
and R. Smith/McIntire School of Commerce
Description of Gift: \$1,080,000 in computing equipment
P. Beling's Portion of Gift: 30%

GRADUATE STUDENT DIRECTION

Ph.D. Dissertation Advisor

1. Tyler Cody, entered program August 2017, degree expected May 2022.
2. Alexander Langevin, entered program August 2018, degree expected May 2022.
3. Yuanji Xie, entered program August 2017, degree expected May 2021.
4. Jianyu Su, entered program August 2016, degree expected May 2020.
5. Cheng Wang, entered program August 2014, degree expected May 2020.
6. Faraz Dadgostari, Ph.D. candidate, degree expected May 2020. **Awarded Presidential Fellowship in Data Science, 2016.**
7. Siyu Lin, Ph.D. candidate, degree expected May 2020.
8. Ben Choo, Ph.D. candidate, degree expected December 2019.
9. Roy Hayes, *Behavior Model Recovery in Agent-based Environments*, Ph.D., Systems Engineering, December 2018. First job after graduation: Systems Engineering, Inc.
10. Xiaomin Lin, *Machine Learning Approaches to Multi-agent Inverse Learning Problems*, Ph.D., Systems Engineering, December 2017. First job after graduation: MetLife.
11. Andrew Todd, *Multi-market Trading: Simulations and Empirical Analysis*, Ph.D., Systems Engineering, December 2016. First job after graduation: Jump Trading.
12. Michael Landau, *Optimal 6D Object Pose Estimation with Commodity Depth Sensors*, Ph.D., Systems Engineering, 2016. First job after graduation: Applied Physics Laboratory.
13. Stephen Adams, *Simultaneous Feature Selection and Parameter Estimation for Hidden Markov Models*, Ph.D., Systems Engineering, 2015. First job after graduation: Research Scientist, Department of Systems and Information, University of Virginia (Currently Principal Research Scientist, supervised by **P. Beling**).

14. Kanshukan Rajaratnam, *Decision Models in Consumer Lending in the Context of Economic Uncertainty*, Ph.D., Systems Engineering, 2014. First job after graduation: Lecturer, Department of Tax and Finance, University of Cape Town, South Africa (currently Associate Professor).
15. Mark Paddrik, *Assessing Financial Markets through System Complexity Management*, Ph.D., Systems Engineering, 2013 (co-advised with William Scherer). First job after graduation: Economist, Office of Financial Research, U.S. Department of Treasury.
16. Yijia Zhao, *Coordination Issues in Cooperative Decentralized Decision Problems*, Ph.D., Systems Engineering, 2013 (co-advised with Stephen Patek). First job after graduation: self-employed consultant.
17. Qifeng Qiao, *Machine Approaches to Epistemic Learning with Application to Decision Strategy Recognition*, Ph.D., Systems Engineering, 2012. First job after graduation: Hitachi Data Systems.
18. Steve Y. Yang, *Behavior Based Algorithmic Trading Strategy Identification*, Ph.D., Systems Engineering, 2012 (co-advised with William Scherer). First job after graduation: Assistant Professor, School of Systems and Enterprises, Stevens Institute of Technology (currently Associate Professor).
19. Lu (Kelly) Gao, *Loan Origination Decision Based on Multiple Scores with Application to Installment Loan Portfolio Selection*, Systems Engineering, 2008. First job after graduation: Fair, Isaac and Company.
20. Xin Zhou, *Statistical Model-Based Object Recognition from Three-Dimensional Point-Cloud Data*, 2008 (co-advised with B. Horowitz). First job after graduation: Assistant Professor, Nanjing University of Aeronautics and Astronautics, China.
21. A. T. Morris, *A Bayesian Network-based Scoring Methodology for COTS Software*, Systems Engineering, 2004. First job after graduation: NASA Langley Research Center.
22. Hui Zhu, *Bayesian Methods for Combining and Constructing Classifiers*, Systems Engineering, 2001. First job after graduation: Fair, Isaac and Company.
23. Venkat Chalasani, *Linear Programming-based Decision Tree Classifiers*, Systems Engineering, 2000. First job after graduation: BAE Systems.
24. Hunter Albright, *Strategies and Tactics for Genetic Algorithms in Solving Multiple Objective Nonlinear Constrained Optimization Problems*, Systems Engineering, 1998 (co-advised with James Ignizio). First job after graduation: Barclay Card.
25. Luong Tran, *Access Area Design and Backbone Design: Models, Analysis, and Solution Procedures*, Systems Engineering, 1997. First job after graduation: Mitre Corporation.

Ph.D. Dissertation Committee Member

1. Kamwoo Lee, Systems Engineering, 2019.
2. Yu Sheng, Electrical Engineering, 2019.
3. Thummaros Rugthum, Electrical Engineering, 2017.
4. Matthew Englehard, Systems Engineering, 2016.
5. Elizabeth Connelly, Systems Engineering, 2015.
6. Yue Sun, Systems Engineering, 2015.
7. Boyi Jiang, Systems Engineering, 2015.
8. Michelle Hamilton, Systems Engineering, 2014.
9. Junrui Xu, Systems Engineering, 2014.
10. Alla Aksel, Electrical Engineering, 2014.
11. Yi Tang, Electrical Engineering, 2013.
12. Jorge Barrera, Systems Engineering, 2013.
13. Yuting Wang, Systems Engineering, 2013.
14. Erik Vargo, Systems Engineering, 2013.
15. Christopher Smith, Systems Engineering, 2013.
16. Haowen You, Systems Engineering, 2013.
17. Rick Jones, Systems Engineering, 2012.
18. Zhou Zhou, Systems Engineering, 2012.
19. Mingyi Hong, Systems Engineering, 2012.
20. Shital Thekdi, Systems Engineering, 2012.
21. Alice Chan, Systems Engineering, 2011.
22. Douglas Lee, Systems Engineering, 2011.
23. Cheng Peng, Systems Engineering, 2009.
24. John Mclin, Systems Engineering, 2008.
25. Nilesh Joshi, Systems Engineering, 2007.

26. Kevin Gormley, Systems Engineering, 2007.
27. Matthew Jones, Systems Engineering, 2006.
28. Maria Leung, Systems Engineering, 2006.
29. Susan Donahue, Systems Engineering, 2006.
30. Kaushik Sinha, Systems Engineering, 2005.
31. William Bland, Systems Engineering, 2004.
32. Ruth Dicdican, Systems Engineering, 2004.
33. Robert Athay, Systems Engineering, 2004.
34. Yifei Xue, Systems Engineering, 2004.
35. Enrique Campos-Nanez, Systems Engineering, 2003.
36. Joost Santos, Systems Engineering, 2003.
37. Jain-Shone Chung, Systems Engineering, 2003.
38. Pu Jiang, Systems Engineering, 2003.
39. Cesar Ariel Pinto, Systems Engineering, 2002.
40. Rod Turlochy, Civil Engineering, 2001.
41. Aysegul Aksoy, Civil Engineering, 2000.
42. Amy Chan, Civil Engineering, 2000.
43. William Williams, Civil Engineering, 1999.
44. Rolf Olsen, Systems Engineering, 1999.
45. Hua Liu, Systems Engineering, 1999.
46. David Warne, Computer Science, 1998.
47. Dale Salmons, Systems Engineering, 1998.
48. Hong Dai, Civil Engineering, 1997.
49. Ganghuai Wang, Systems Engineering, 1997.
50. John Kros, Systems Engineering, 1997.
51. James Soltys, Systems Engineering, 1996.

52. Anup Ghosh, Electrical Engineering, 1996.
53. Evelyn Brown, Systems Engineering, 1996.
54. Vijay Tulsiani, Systems Engineering, 1995.

M.S. Thesis Advisor

1. Ryan Meekins, *A Multiple Objective Classifier Selection Methodology for Real World Problems*, M.S., Systems Engineering, May 2018.
2. Gerry Heddy, *A Simulation Environment to Support Prognostics and Health Management in Smart Manufacturing Systems*, M.S., Systems Engineering 2016.
3. Michael Malinowski, *Harmonizing Prognostics and Health Management with Risk Analysis for Smart Manufacturing Systems*, M.S., Systems Engineering, 2016 (co-advised with Yacov Haimes).
4. Muhammad Hassan, *Non-stationary Contextual Multi-armed Bandit*, M.S., Systems Engineering, 2015 (co-advised with Hongning Wang).
5. Zoe Zhang, *Selective Factorized Coupled Hidden Markov Model*, M.S., Systems Engineering, 2014.
6. Roy Hayes, *Action-based Feature Representation for Reverse Engineering Trading Strategies*, M.S., Systems Engineering, 2013.
7. Barbara Luckett, *Integration of Graphical Modeling Techniques as a Structural Framework for System-Aware Cyber Security Architecture Selection*, M.S., Systems Engineering, 2013.
8. Irwin Reyes, *Trade-Offs in Computation and Communication for Automatic Target Recognition in Constrained Wireless Systems*, M.S., Systems Engineering, August 2011.
9. Mihnea Birisan, *Improving Operator Effectiveness using Multi-Instance Learning*, M.S., Systems Engineering, 2011.
10. Jonathan Bao, *Use of Inverse Reinforcement Learning for Identity Prediction*, M.S., Systems Engineering, 2010 (co-advised with B. Horowitz).
11. Jie Xing, *A Refined 2D Machine Vision System for Positioning an Industrial Robot*, M.S., Systems Engineering, 2009.
12. David Redard, *A Performance-Estimation-Based Tree Algorithm for Reducing Computation in Automatic Target Recognition*, Systems Engineering, 2008.

13. Shanka Basu, *A High-Level Modeling Framework for Total System Performance of Automated Target Recognition in Distributed Surveillance Systems*, Systems Engineering, 2008.
14. Eric Rains, *A Competitive Equilibrium Based Model for Intergenerational Risk Sharing*, Systems Engineering, 2008.
15. Alexander Mosenthal, *An Approximate Dynamic Programming Approach to Valuing American-style Asian Options*, Systems Engineering, 2004.
16. Faheem Rahman, *Systems Analysis and Adaptive Learning for Portfolio Management of Superfund Sites*, Systems Engineering, 2003 (co-advised with J. Lambert).
17. Nicolas Transier, *Towards Visualizing High-dimensional Clustering Output*, Systems Engineering, 2003.
18. Timothy Stroud, *Patent Litigation and Risk Assessment Modeling*, Systems Engineering, 2003.
19. David Okano, *Response Surface Methodology for Validation of Many-factor Simulation Models*, Systems Engineering, 2003.
20. John Willis, *Optimization of Credit Union Membership Portfolios*, Systems Engineering, 1999.
21. Jason Misner, *Head Motion in Eye Tracking Systems*, Systems Engineering, 1999 (co-advised with T. Hutchinson).
22. Silla Mullei, *Adaptive Rule-Based Construction of Credit and Stock Portfolios*, Systems Engineering, 1998.
23. Phillip Long, *Characterizing and Exploiting Interior Point Information in Obtaining an Optimal Linear Programming Basis via a Hybrid Barrier-Simplex Algorithm*, Systems Engineering, 1996.

M.S. Committee Member

1. Matthew Rodriguez, Systems Engineering, 2019
2. Nikesh Kapadia, Systems Engineering, 2019
3. Mark Rucker, Systems Engineering, 2018
4. Debo Datta, Systems Engineering, 2016.
5. Keira Zhou, Systems Engineering, 2015.
6. Michael Lukas, Systems Engineering, 2015.

7. Matthew McFarland, Systems Engineering, 2014.
8. Kelly Lafferty, Systems Engineering, 2013.
9. Elizabeth Connelley, Systems Engineering, 2013.
10. Michelle Hamilton, Systems Engineering, 2010.
11. Sung Nam Hwang, Systems Engineering, 2009.
12. David Czarnecki, Systems Engineering, 2009.
13. Rick Jones, Systems Engineering, 2008.
14. Brett Dickey, Systems Engineering, 2008.
15. Evan Tschannen, Systems Engineering, 2008.
16. Joshua Stafford, Systems Engineering, 2005.
17. Brian Mahoney, Systems Engineering, 2001.
18. Claudia Handal, Systems Engineering, 2000.
19. Michael Cobb, Systems Engineering, 2000.
20. Tyler Beam, Systems Engineering, 1999.
21. Robert Watson, Systems Engineering, 1998.
22. Shawn Morrow, Systems Engineering, 1998.
23. Stephan Anderson, Systems Engineering, 1997.
24. Joshua Park, Systems Engineering, 1996.
25. Richard Curry, Systems Engineering, 1996.
26. David Knauff, Systems Engineering, 1995.
27. Todd Godkin, Systems Engineering, 1994.

M.E. Academic Advisor

Average academic advising load of 2 M.E. students per year.

UNDERGRADUATE STUDENT ADVISING

Academic Advisor

Average academic advising load of 30 B.S. students per year.

Thesis/Capstone Technical Paper Advisor

1. K. Wu, *Risk Analysis of Globalization of Airplane Supply Chains*, Technical Paper, 2016.
2. J. Gregoire, *Risk Analysis of Globalization of Airplane Supply Chains*, Technical Paper, 2016.
3. E. Shank, *Risk Analysis of Globalization of Airplane Supply Chains*, Technical Paper, 2016.
4. J. Kozloski, *Risk Analysis of Globalization of Airplane Supply Chains*, Technical Paper, 2016.
5. D. Ofiesh, *Risk Analysis of Globalization of Airplane Supply Chains*, Technical Paper, 2016.
6. E. Bains, *Risk Analysis of Globalization of Airplane Supply Chains*, Technical Paper, 2016.
7. C. Putnam, *Forecasting Intraday Volume Distributions*, Technical Paper, 2015.
8. T. Shank, *Forecasting Intraday Volume Distributions*, Technical Paper, 2015.
9. N. Brayer, *Forecasting Intraday Volume Distributions*, Technical Paper, 2015.
10. A. Ngo, *Forecasting Intraday Volume Distributions*, Technical Paper, 2015.
11. J. Nettles, *Forecasting Intraday Volume Distributions*, Technical Paper, 2015.
12. J. Radcliffe, *Analysis of Manual Manufacturing Processes using Motion Sensing Technologies*, Technical Paper, 2014.
13. K. Chung, *Analysis of Manual Manufacturing Processes using Motion Sensing Technologies*, Technical Paper, 2014.
14. M. Ghariban, *Analysis of Manual Manufacturing Processes using Motion Sensing Technologies*, Technical Paper, 2014.
15. W. Han, *Analysis of Manual Manufacturing Processes using Motion Sensing Technologies*, Technical Paper, 2014.

16. J. Wei, *Analysis of Manual Manufacturing Processes using Motion Sensing Technologies*, Technical Paper, 2014.
17. C. Lacy, *Systemic Risk in the United States Banking Industry*, Technical Paper, 2014.
18. J. Peruski, *Systemic Risk in the United States Banking Industry*, Technical Paper, 2014.
19. M. Boegner, *Systemic Risk in the United States Banking Industry*, Technical Paper, 2014.
20. H. Gorog, *Systemic Risk in the United States Banking Industry*, Technical Paper, 2014.
21. W. Goethal, *Systemic Risk in the United States Banking Industry*, Technical Paper, 2014.
22. J. Byers, *Systemic Risk in the United States Banking Industry*, Technical Paper, 2014.
23. Jeffrey Delpresto, *Safe Lifting: An Adaptive Training System for Factory Workers Using the Microsoft Kinect*, Technical Paper, 2013.
24. Duan Chuhong, *Safe Lifting: An Adaptive Training System for Factory Workers Using the Microsoft Kinect*, Technical Paper, 2013.
25. Lara Layiktez, *Safe Lifting: An Adaptive Training System for Factory Workers Using the Microsoft Kinect*, Technical Paper, 2013.
26. Eyitemi Moju-Igbene, *Safe Lifting: An Adaptive Training System for Factory Workers Using the Microsoft Kinect*, Technical Paper, 2013.
27. Matthew Wood, *Safe Lifting: An Adaptive Training System for Factory Workers Using the Microsoft Kinect*, Technical Paper, 2013.
28. Dan C. Burkert, *A Real-time Ergonomic Monitoring System using the Microsoft Kinect*, Technical Paper, 2012.
29. Kyung R. Cho, *A Real-time Ergonomic Monitoring System using the Microsoft Kinect*, Technical Paper, 2012.
30. Nick B. Wiczorek, *A Real-time Ergonomic Monitoring System using the Microsoft Kinect*, Technical Paper, 2012.
31. Chris C. Martin, *A Real-time Ergonomic Monitoring System using the Microsoft Kinect*, Technical Paper, 2012.
32. Patrick M. McGregor, *A Real-time Ergonomic Monitoring System using the Microsoft Kinect*, Technical Paper, 2012.

33. Richard A. Herrmann, *A Real-time Ergonomic Monitoring System using the Microsoft Kinect*, Technical Paper, 2012.
34. Albert Mayo, *Development of an Operator Interface for a Multi-Sensor Overhead Surveillance System*, Technical Paper, 2011.
35. Daniel Bocknek, *Development of an Operator Interface for a Multi-Sensor Overhead Surveillance System*, Technical Paper, 2011.
36. Cameron Blake, *Development of an Operator Interface for a Multi-Sensor Overhead Surveillance System*, Technical Paper, 2011.
37. Randolph Rittenhouse, *Development of an Operator Interface for a Multi-Sensor Overhead Surveillance System*, Technical Paper, 2011.
38. Brian Boswell, *Development of an Operator Interface for a Multi-Sensor Overhead Surveillance System*, Technical Paper, 2011.
39. Michael Forte, *Learning Human Behavioral Profiles in a Cyber Environment*, Technical Paper, 2010.
40. Christopher Hummel, *Learning Human Behavioral Profiles in a Cyber Environment*, Technical Paper, 2010.
41. Nicolas Morris, *Learning Human Behavioral Profiles in a Cyber Environment*, Technical Paper, 2010.
42. Eric Pratsch, *Learning Human Behavioral Profiles in a Cyber Environment*, Technical Paper, 2010.
43. Rita Shi, *Learning Human Behavioral Profiles in a Cyber Environment*, Technical Paper, 2010.
44. Matthew Barry, *Scoring Models as a Tool for Teacher Self-Assessment*, Technical Paper, 2009.
45. Darius A. Thevathasan, *Scoring Models as a Tool for Teacher Self-Assessment*, Technical Paper, 2009.
46. Tarik A. Yousif, *Scoring Models as a Tool for Teacher Self-Assessment*, Technical Paper, 2009.
47. Karen Cheng, *Track Based Characterization of Vehicle Behavior*, Technical Paper, 2009.
48. Francis J. Tumbokon, *Track Based Characterization of Vehicle Behavior*, Technical Paper, 2009.

49. Ritwik Sahu, *Track Based Characterization of Vehicle Behavior*, Technical Paper, 2009.
50. Hillary Chandler, *The Creation of Emergent Behavior in a Traffic Simulation Model Using Four-Way Intersections to Test Behavior Characterization*, Technical Paper, 2009.
51. Sheung Yin Kevin Mo, *Quantitative Assessment of Cyber Security Risk using a Bayesian Network-based Model*, Technical Paper, 2009.
52. Paxton Flesher, *Analyzing an Investment Strategy that Selects Assets Based on Earnings Yield and Return on Invested Capital*, 2008.
53. Robert Turner, *Simulation and Optimization of Investment Strategies: Optimal Allocation versus Index Weighting*, 2008.
54. Stephen Wegner, *Development and Optimization of Investment Strategies: A Time Series Analysis of the Carry Trade*, 2008.
55. Andrew Pascoe, *An Investigation of Log-Optimization and Stock Allocation Strategy on Large Cap U.S. Equities*, 2008 (Technical Paper).
56. Misael Negash, *An Investigation of Log-Optimization and Stock Allocation Strategy on Large Cap U.S. Equities*, 2008 (Technical Paper).
57. Tae Uck Kang, *Wireless Camera Surveillance System: Integrating the Graphic User Interface and the Utility Algorithm into the Prototype Mobile Information Processing Architecture*, 2008.
58. Bum chul Kwon, *Wireless Image Delivery with Limited Bandwidth and Processing Capacity*, 2008.
59. Scott F. Meadows, *Optimization of Investment Strategies: Time Series Analysis and Options on Foreign Exchange*, 2008.
60. Rebecca McCrabb, *Evaluation of Video Imaging Localization System for a Decentralized Control System*, 2007.
61. Huma Hussein, *Developing a Test-bed for Distributed Search by Mobile Sensors*, 2007.
62. Laura Paulsen, *A Simulation Test Environment for Algorithms Designed to Optimize Coordinated Decision-Making among Autonomous Agents*, 2006.
63. Philip Noakes, *Dynamic Multi-agent Coordination*, 2006.
64. Benjamin Verley, *Game Theory Coordination Problem: Test Bed Design, Development and Documentation*, 2006.

65. James Weightman, *Dynamic Multi-Agent Coordination for the NASA Langley Research Center*, 2006.
66. Matthew Flannagan, *Development of a Software Environment for testing Coordinated Decision-making Processes*, 2006.
67. Elizabeth Verell, *Robocops: Multi-agent Coordination in the Absence of Communication*, 2005.
68. Brad Beaulieu, *Dynamic Multi-agent Coordination: Robocops*, 2005.
69. Imhotep Durham, *Robocops: Dynamic Multi-agent Coordination*, 2005.
70. Ryan McKinstrie, *Dynamic Multi-agent Coordination (RoboCops)*, 2005.
71. Paul Shumate, *Robocops: Dynamic Multi-agent Coordination*, 2005.
72. Kyle Stamper, *Toward a Publicly-accessible Database of Historical, Intraday Stock Prices*, 2005.
73. Michael Chen, *Systems Analysis of Economic Impacts of Redeveloped Superfund Sites*, 2004.
74. Manish Garg, *Development of an Economic Impact Decision Aid for Superfund Sites*, 2004.
75. Connie Lin, *Case Study of Teamwork: a Capstone Project*, 2004.
76. Leena Patel, *Systems Analysis on the Economic Impacts of Superfund Site Remediation*, 2004.
77. Henry Wong, *Developing an Economic Impact Decision Aid for Remedy and Reuse Decisions at EPA Superfund Sites*, 2004.
78. Michael Brinn, *Relationship Between Forward Citations and a Patent's Portfolio*, 2003.
79. Julia Fleming, *Patent Value: Assessing the Merit of Patent Citation Analysis*, 2003.
80. Fernando Hannaka, *Analysis of Forward Citation Count in Patent Valuation Methods*, 2003.
81. Colin Thomas, *Patent Citation Networks: A Method for Determining Patent Value*, 2003.
82. Prae Dumrong, *The Development of An Automated Process to Quantify Unstructured Data: A Way To Transform Unstructured Data To be Used in Predictive Modeling*, 2003.

83. Logan Nicholson, *The Use of Unstructured Information in Predictive Modeling*, 2003.
84. Jared Gould, *Methods of Scoring the Federal Reserve's Beige Books to Better Understand Unstructured Information*, 2003.
85. Mark Michalski, *Organized Theft and Fraud at Progressive: A Plan for Reduction*, 2002 (co-advised with James Lark).
86. Andrew Kaplan, *Point of Sale Fraud Detection at Progressive Casualty Insurance*, 2002 (co-advised with James Lark).
87. Jeffrey Grossman, *Fraud Detection Models for Automobile Insurance*, 2002 (co-advised with James Lark).
88. Carlton Pate, *Point of Sale Fraud Identification in the Automobile Insurance Industry*, 2002 (co-advised with James Lark).
89. Alex Kim, *Litigation Risk Scoring for Patents*, 2002.
90. Michael Santamaria, *Litigation Risk Scoring Model for Patents*, 2002.
91. Nick Partee, *Development of a Patent Litigation Prediction Model: Analysis of Risk of Patent Infringement Litigation Associated With Intellectual Property Based on Historical Data*, 2002.
92. Teddy Reynolds, *The Value of Intellectual Property: A Litigation Risk Scoring Model for Patents*, 2002.
93. John Schneip, *Design of a User Interface for a Credit Lending Strategy Decision Tool*, 2002.
94. Rebecca Turbush, *A Data Visualization Tool for Credit Portfolio Management*, 2002.
95. Can Arkali, *Implementation of Data Visualization Tools for Credit Portfolio Management*, 2002.
56. Andrew Wollerstein, *Developing Data Visualization Tools for the Management of Credit Portfolios*, 2002.
55. Farzad Arefzadeh, *Algorithm Assessment for Online Advising Tool*, 2001 (co-advised with C. Mastrangelo).
96. Ahmet Atamen, *First Union eChannels: Design of Interactive Advising Tool*, 2001 (co-advised with C. Mastrangelo).
97. Andrew Evanchik, *Design of an Online Financial Advisor*, 2001 (co-advised with C. Mastrangelo).

98. Murat Yucel, *Interactive Decision Support System for First Union*, 2001 (co-advised with C. Mastrangelo).
99. Geoff Ballard, *Algorithms and Software for Credit Portfolio Optimization*, 2001.
100. Steven Tropello, *Web Components for an Efficient Frontier Curve Web Application*, 2001.
101. Jason Katz, *The Design of a Graphical User Interface to Plot Credit Strategies and Efficient Frontier Curves*, 2001.
102. Jeffrey Campbell, *Credit Card Analysis using the Score Cutoff Analysis Tool*, 2001.
103. Jason Ricketts, *An Automated Patent Classification System to Facilitate the Pricing of Intellectual Property*, 2001.
104. Rina Paz, *A Statistical Tool to Assess the Consistency of Patent Classification*, 2001.
105. John Messina, *Improving Patent Organization with an Automated Classification Assessment Tool*, 2001.
106. Tom Cowley, *Electronic Procurement at the University of Virginia*, 2001.
107. Jason Eshler, *Analyzing Patent Classification using Morphogenetic Sets*, 2000.
108. Allen J. Thompson, *Strategically Restructuring the University of Virginia's Procurement Process using Electronic Commerce Solutions: a Business Case*, 2000.
109. Shawn Rush, *Analysis of Cataloguing Methods for an Electronic Procurement Solution at the University of Virginia*, 2000.
110. Jeffrey Feldman, *Influence of SML on the University of Virginia's Consideration of E-procurement*, 2000.
111. Deep Shah, *Analyzing Electronic Procurement Solutions for the University of Virginia*, 2000.
112. Josh Kinsler, *A Credit Card Collection System Study and Simulation*, 1999.
113. Nicole Zosa, *Development of Predictive Models of Customer Response in a Credit Card Collections System*, 1999.
114. Dan Huntzinger, *An Evaluation of IP Telephony at SNL Securities*, 1999.
115. Gregory Haydasz, *An Improved Collection System for a Credit Card Company: The Control Strategy*, 1999.
116. Manjula Perera, *Mobile Computing: Development of a Lending Application for Palmtop Computers*, 1999.

117. Burce Kabatepe, *Feasibility of Mobile Banking and Loan Processing on Handheld Devices*, 1999.
118. Jay Koo, *Design and Implementation of a Mobile Banking System with 3Com PalmPilots*, 1999.
119. Donald Chesworth, *PBX vs. IP PBX: A Method for Handling Incoming Calls and its Performance under Competitive Telephone Systems*, 1999.
120. Michael Lau, *Negotiation as a Vehicle for the Collection of Credit Card Debt*, 1999.
121. Cabral Thornton, *The Development of a Computer Telephony Integration Software Application at SNL Securities*, 1999.
122. Gregory Smith, *Computer Telephony Integration at SNL Securities*, 1999.
123. Christopher Langhorne, *Portfolio Optimization Models for Credit Collections*, 1999.
124. Kym McCammon, *Application Development Environments for PalmPilots*, 1999.
125. Robert Jansen, *An Expert Decision System for a Web-based Credit Scoring System*, 1998.
126. Yavuz Kaynar, *Center for Mobile Information Technology: Design of a Marketing Survey to Evaluate the Center*, 1998.
127. Michael Fadely, *An Examination of Today's and Tomorrow's Smart Card Technology*, 1998.
128. Eric Popowich, *A Conceptual Design and Feasibility Analysis of Center for Mobile Information Technology Educational Services*, 1998.
129. Bret Davis, *Developing an Internet Survey for an Online Credit-scoring System*, 1998.
130. Christian Thompson, *Developing a Management Control System for an Online Credit Scoring System*, 1998.
131. Adam Duncan, *An Aggregate Model: The Center for Mobile Information Technology at the University of Virginia*, 1998.
132. Nicholas Wasko, *Automatic Report Generation for an Online Credit Scoring Application*, 1998.
133. Brandon Shelton, *Report Generation Tool for a World Wide Web Credit Scoring Application*, 1998.
134. Todd Dicke, *A Knowledge Center for Mobile Information Technology: The Design and Prototype*, 1998.

135. Eric Page, *Implementing a World Wide Web Based Credit Scoring System: Disaster Recovery Planning*, 1997.
136. Andrew Stevens, *A Model for Securing a Business Process on the Web*, 1997.
137. Abbas Valliani, *Managing Internet Security: Design and Implementation of a System to Allow Secure Transactions Involving Credit Information on the Internet*, 1997.
138. Scott Irwin, *Internet-based Credit Evaluation Systems: Use of the World Wide Web to Market Credit Scores to Small Banks*, 1997.
139. Ashun Jilani, *WWW-Based Credit Evaluation System: Focus on Internet Security*, 1997.
140. Dennis Pike, *Graphical User Interface for a World Wide Web Based Credit Scoring Evaluation System*, 1997.
141. T. Amber Cajulis, *Use of Java Database Connectivity (JDBC) in a Web-based Credit Evaluation System*, 1997.
142. Myles Standish, *Analysis of Visual Scanning Processes: A Study of Eye-gaze Dwells and Pupil Diameter Changes during Visual Analysis*, 1996.
143. Carlos Espinoza, *Research on the Feasibility and Advantages of an Ocular Tracking System based on Structured Lighting*, 1996.
144. Alexander Gonenne, *Implementing a Wide-Area Network for SNL Securities, L.P.*, 1995.
145. Bradley Bridges, *Document Imaging Feasibility for SNL Securities*, 1995.
146. Kenneth Yagen, *Reengineering SNL Document Retrieval's Customer Order Fulfillment Process: A Systems Analysis*, 1995.
147. Zachary Lyons, *Strategic Organization Analysis and Design: A Case Study of SNL Document Retrieval*, 1995.
148. Kristin Heinz, *Reengineering Data Acquisition for SNL Securities: A Systems Analysis*, 1995.
149. John Barron, *A Feasibility Study of Document Imaging at SNL Securities*, 1995.

VISITORS AND POSTDOCTORAL FELLOWS SUPERVISED

- Sponsored Kanshukan Rajaratnam, Associate Professor at the University of Cape Town, for the position of Visiting Professor in the SIE Department and hosted 6 month visit beginning summer 2016.
- Supervisor for Dr. Stephen Adams, UVA Principal Research Scientist (Fall 2015-present).
- Coordinated visit by Professor Antoaneta Serguieva, University College London (Fall 2014).
- Sponsored Robert M. Oliver, Professor Emeritus from the University of California at Berkeley and member of the National Academy of Engineering, for the position of Distinguished Visiting Professor in the SIE Department. He held this position from Fall 2007 to Fall 2012. Hosted Professor Oliver while he was in residence during the Spring 2008 semester. This collaboration included jointly teaching a graduate course in financial engineering.

SERVICE TO THE UNIVERSITY AND PROFESSION

Extramural Panels

- Team lead (mathematics) for National Academies study *Information Science at the Army Research Office*, 2018.
- Committee member for National Academies study *Information Science at the Army Research Laboratory*, 2015, 2016, 2018, 2019.
- Committee member for National Academies panel *Improving the Decision Making Abilities of Small Unit Leaders*; Naval Studies Board; Division on Engineering and Physical Sciences; 2010–2012.
- Provost's Review Panel, *Systems Engineering at Boston University*, 2018.
- National Science Foundation proposal review panels, including: Cyber-physical Systems; Industry University Cooperative Research Center; Humans, Disasters, and the Built Environment; Cyber Infrastructure.

University Service

- Reviewer for Pan-University Institute proposals, 2015.
- UVA Representative to the Industrial Operations Board of the Commonwealth Center for Advanced Manufacturing, 2014–2019.

- Faculty Recruiting, Retention, and Welfare Committee, 2005–2007.
- Faculty Senator, 2003–2006.
- Computer Science Program Review Committee, 1998.

School of Engineering and Applied Science Service

- Chair, Cybersecurity Cross-cut Faculty Search, 2018–2019.
- Steering Committee member for cluster hire in cyber-physical systems. Co-lead for position on security and safety, 2015-2016.
- Graduate Studies Committee, 2013–2016.
- Dean’s Finance Committee, 2012–2014.
- Faculty Council, 2003–2006.
- Bylaws Committee, 1994–95.
- CS 101 Advisory Committee, 1994–96.
- Open House Committee, 1994–96, 1998.
- Undergraduate Research and Design Symposium Committee, 1994–97.
- First-year Advising Program, 1997–98.
- Organizer, Information Technology session, SEAS Research Retreat, 1997.
- Presenter, Engineering Open House for Underrepresented Students, 1995.
- Speaker, SEAS Reunion Day, 1995.
- Undergraduate Curriculum Committee, 1999–2001.
- Teaching Evaluation Committee, 2000–2001

Department Service

- Associate Chair for Research, Department of Engineering Systems and Environment, 2018–present.
- Interim Chair, Department of Systems and Information Engineering, 2017–2018.
- Promotion and Tenure Committee, 2000–present.
- Space and Equipment Committee, Chair, 2016–2017.

- Graduate Studies Committee, Chair, 2013–2016.
- Undergraduate Studies Committee, Chair: 1999–2005.
- Budget Committee, Chair, 2008–2016.
- Faculty Search Committee, Chair for subcommittee on cyber-physical systems, 2014–2015.
- Faculty Search Committee, Chair for cyber-physical manufacturing area, 2012–2013.
- Professional Research Staff Search, Chair for cyber-physical manufacturing area, 2013.
- Capstone Competition Committee, 1993, 1999–2001.
- Promotional Activities Committee, 1993–1995.
- Department Newsletter Committee, 1994–1996.
- Undergraduate Program Committee, 1993–98.
- Graduate Program Committee, 1996.
- Dupont Scholarship Committee, 1996.
- Space and Equipment Committee, 1997–2001.
- Department Marshal, Graduation Ceremonies, 1995–97, 1999, 2002–2009.
- Department Representative, Majors Night, 1993–2001.
- Department Representative, Family Weekend, 1994–2001.
- Faculty Advisor, Omega Rho Honor Society, 1995–2001.

PROFESSIONAL PRACTICE

Editorial Service

- *Data-Enabled Discovery and Applications*, Guest Editor for special issue, 2019–present.
- *Journal of Defense Modeling and Simulation*, Guest Editor for special issue, 2018–present.
- *Systems Engineering*, Guest Editor for special issue, 2018–2019.
- *International Journal of Prognostics and Health Management*, member Editorial Board, 2016–present.

- *Journal of the Operational Research Society*, Guest Editor for special issue, 2013–2015.
- *Environment Systems & Decisions*, member Editorial Board, 2012–present.
- *Environment Systems & Decisions*, Guest Editor for three special issues, 2012–2013, 2015–2016, 2018–2019.
- *IEEE Transactions on Systems, Man, and Cybernetics Part A*, Associate Editor, 2002–2006.
- *International Journal of Parallel and Distributed Systems and Networks*, Associate Editor, 1998–2000.
- *International Abstracts in Operations Research*, Associate Editor, 1995–2000.
- Referee: *Algorithmica*; *Automatica*; *Computational Optimization and Applications*; *Computers and Operations Research*; *Computers and Security*; *European Journal of Operations Research*; *IEEE Transactions on Systems, Man, and Cybernetics*; *Interfaces*; *International Journal of Prognostics and Health Management*; *Linear Algebra and Its Applications*; *Journal of the Operational Research Society*; *Mathematical Programming*; *Multi-Criteria Decision Analysis*; among others.

Workshop and Conference Organization

- Faculty Lead, Workshop on Systems Engineering for Artificial Intelligence, Systems Engineering Research Center & Army Futures Command, 2019.
- General Co-Chair, 2018 Conference on Systems Engineering Research (CSER 2018).
- Program Committee member, 2018 IEEE Symposium on Computational Intelligence for Financial Engineering and Economics (CIFEr 2018).
- General Co-Chair, 2017 International Conference of the Prognostics and Health Management Society (PHM 2017).
- Program Committee member, 2017 IEEE Symposium on Computational Intelligence for Financial Engineering and Economics (CIFEr 2017).
- Program Committee member, 2016 IEEE Symposium on Computational Intelligence for Financial Engineering and Economics (CIFEr 2016 as part of IEEE SSCI 2016).
- Co-Chair of the Technical Program Committee, 2016 International Conference of the Prognostics and Health Management Society (PHM 2016).
- Program Committee member, 2015 IEEE Symposium on Computational Intelligence for Financial Engineering and Economics (CIFEr 2015 as part of IEEE SSCI 2015).

- Competition Committee Chair, 2014 IEEE Symposium on Computational Intelligence for Financial Engineering and Economics (CIFEr 2014).
- Program Committee member, 2014 IEEE Symposium on Computational Intelligence for Financial Engineering & Economics (CIFEr 2014).
- Program Committee member, 2006 IEEE Conference on Systems, Man, and Cybernetics (SMC 2006).
- Program Committee member, 2005 IEEE Conference on Systems, Man, and Cybernetics (SMC 2005).
- Program Committee member, 2004 IEEE Conference on Systems, Man, and Cybernetics (SMC 2004).
- Program Committee member, 2003 IEEE Conference on Systems, Man, and Cybernetics, Washington (SMC 2003).
- Co-organizer, Banff Credit Risk Conference, Banff International Research Station (co-sponsored by MSRI and NSF), 2003.
- Finance Chair, 2003 IEEE Conference on Systems, Man, and Cybernetics, Washington (SMC 2003).
- Co-organizer, Workshop on Interdisciplinary Approaches to Transforming Contaminated Sites (co-sponsored by EPA and the Center for Excellence in Superfund Site Recycling), 2003.
- Program Committee member, 2002 IEEE Conference on Systems, Man, and Cybernetics (SMC 2002).
- Program Committee member, 2001 IEEE Conference on Systems, Man, and Cybernetics (SMC 2001).
- Program Committee member, 2000 IEEE Conference on Systems, Man, and Cybernetics (SMC 2000).
- Session Organizer, 2000 IEEE Conference on Systems, Man, and Cybernetics (SMC 2000).
- Program Committee member, 1999 IEEE Conference on Systems, Man, and Cybernetics (SMC 1999).
- Session Organizer, 1999 IEEE Conference on Systems, Man, and Cybernetics (SMC 1999).
- Session Organizer, 1998 IEEE Conference on Systems, Man, and Cybernetics (SMC 1998).

- Session Organizer, 1998 IEEE Conference on Systems, Man, and Cybernetics (SMC 1998).
- Session Organizer, IMACS/IEEE Conference on Computational Engineering in Systems Applications, Hammamet, Tunisia, April, 1998.
- Organizer, University of Virginia Workshop on a Center for Mobile Information Technology, Charlottesville, VA, 1998. Approximately 50 participants. Sponsored by Virginia's Center for Innovative Technology.
- Local Organizing Committee member, 14th International Conference on Multiple Criteria Decision Making, Charlottesville, VA, 1998.
- Session Organizer, 1997 IEEE Conference on Systems, Man, and Cybernetics, Orlando, 1997.
- Session Organizer, Informs National Meeting, Atlanta, 1996. Sessions sponsored by the INFORMS Computer Science Technical Section.

Professional Society Engagement

- Member, Computational Finance and Economics Technical Committee, IEEE Computational Intelligence Society, 2014-2019.
- Vice President for Publications, IEEE Society on Systems, Man, and Cybernetics, 2003–2005.
- Webmaster, IEEE SMC Society, 2002–2004.
- Chair, Technical Committee on Optimization, IEEE Society on Systems, Man, and Cybernetics, 1997–2001.
- Administrative Committee, IEEE Society on Systems, Man, and Cybernetics, 1999–2000.
- Executive Committee, and Regional Director, Omega Rho Operations Research Honor Society, 1997–2001.
- Member: Institute of Electrical and Electronic Engineers; Institute of Industrial Engineers; International Association of Financial Engineers; Institute for Operations Research and the Management Sciences; Mathematical Optimization Society.

CITIZENSHIP, MENTORING, AND OUTREACH

- Faculty sponsor for minority undergraduate students in NSF Research Experiences for Undergraduates (REU) site, 2016–2019, and various supplemental awards, 2008–2019.
- Faculty sponsor for minority undergraduate students in SIE Department’s URISE program, 2011–2012.
- Faculty Mentor, UVA Summer Robotics Program, 2007–2009.
- Mentor, Monticello High School science program, 2004–2005.
- David A. Harrison Award for Undergraduate Advising, University of Virginia, 1999.
- Presenter, Engineering Open House, 1996–98, 2008–2019.
- Presenter, Central Virginia Governor’s School Outreach Program, 1994–95.

EXTERNAL CONSULTING

- *Austin Labs LLC*, principal in data science practice, 2012–present.
- *Ethics Metrics LLC*, bank risk models and member of Advisory Board, 2015–present.
- *Robins, Kaplan, Miller, and Ciresi LLP*, mortgage risk models, 2012–2014.
- *Commodity Futures Trading Commission*, models of systemic risk arising from high frequency trading, 2011–2013.
- *Consumer Financial Protection Bureau*, analysis of fair lending compliance, 2012–2013.
- *Robins, Kaplan, Miller, and Ciresi LLP*, credit scoring models, 2007–2009.
- *Elder Research*, credit scoring models, 1999–2001.