

Curriculum Vitae

Wei Xie

Assistant Professor

Department of Industrial and Systems Engineering

Rensselaer Polytechnic Institute

110 8th Street, Center for Industrial Innovation, Room 5207

Troy, NY 12180-3590

Email: xiew3@rpi.edu

Phone: 518-276-6622

Website: <http://faculty.rpi.edu/wei-xie>

Research Interests

My research interests focus on computer simulation, data analytics, risk and reliability management with applications, including supply chains, biopharmaceutical manufacturing, smart power grids, semiconductor manufacturing, and transportation infrastructure maintenance.

Education

NORTHWESTERN UNIVERSITY (NU), EVANSTON IL, USA

- Ph.D Industrial Engineering and Management Sciences June 2014
 - Dissertation Title: Statistical Uncertainty Analysis for Stochastic Simulation
 - Advisors: Barry L. Nelson, Russell R. Barton

UNIVERSITY OF NEBRASKA-LINCOLN, LINCOLN NE, USA

- M.S. Engineering Mechanics Aug. 2005
 - Thesis Title: Peridynamic Flux-Corrected Transport Algorithm for Shock Wave Studies
 - Advisor: Florin Bobaru
- Minor: Electrical Engineering

YANGTZE UNIVERSITY, JINGZHOU CHINA

- B.S. Mechanical Engineering June 1997

Current Ph.D. Students

- Bo Wang, August 2016 – present (finish one journal paper and one winter simulation conference paper; finalist of 2017 INFORMS best student paper on Quality, Statistics and Reliability; expected graduation time: Summer 2019)
- Pu Zhang, August 2015 – present (finish two journal papers and one winter simulation conference paper; 2017 summer intern at Goldman Sachs; received a job offer from Goldman Sachs; expected graduation time: Summer 2018)
- Yuan Yi, August 2014 – present (finish two journal papers and two winter simulation conference papers; 2017 summer intern at Argonne National Laboratory; single winner of 2017 RPI Industrial and System Engineering research award; expected graduation time: Summer 2018)

Honors and Awards

- My two papers, “A Bayesian Framework for Quantifying Uncertainty in Stochastic Simulation” and “Quantifying Input Uncertainty via Simulation Confidence Intervals”, collaborated with Barry L. Nelson and Russell R. Barton, received the 2015 outstanding publication award from the INFORMS Simulation Society.

Research Experience

- *Data-Driven Reliability Management for Smart Power Grids with Renewable Energy* February 2017 – present
 - Collaborate with Zhi Zhou from Argonne National Laboratory.
 - As renewable energy resources, e.g., wind power, are being rapidly integrated into power systems, the forecast uncertainty brings operational challenges. To improve the economic efficiency and system reliability, we propose a Bayesian framework that can guide the power grid scheduling and determine the adaptive operating reserves hedging against various sources of uncertainty. To improve the forecast of future wind energy production at various wind farms, we propose a prediction model that could extract as much information as available from the historical data. A new stochastic optimization approach accounting for the inherent stochastic uncertainty from renewable energy and contingencies, the model risk and the finite scenario approximation uncertainty is introduced to dynamically find the optimal and robust unit commitment and economic dispatch.
- *Data-driven Risk Management for End-to-end Supply Chains in Biopharmaceutical Manufacturing* October 2014 – present
 - Supply chain management in biopharma manufacturing faces various challenges, including long lead times, the limited availability of raw materials, high uncertainty in supply, testing and clinical demand, frequent launches of new products. To deal with these challenges, we consider an end-to-end supply chain integrating the research development and develop a simulation-based prediction framework to guide the coherent decision making in capacity investment, procurement, testing and production scheduling, which could hedge against various sources of uncertainty and speed up the time to market. We propose a long-term forecast model for clinical demand planning and introduce a simulation-based two-stage optimization for capacity planning. To control the impact of supply volatility and efficiently use each batch of available raw materials, we propose a new scenario-based scheduling decision making for testing and production.
- *Stochastic Simulation Calibration for Production Scheduling and Control in Semiconductor Manufacturing* October 2016 – present
 - For a complex semiconductor production system, a simplified simulation model is often used to guide the real-time production scheduling and control. To provide a reliable decision guidance, we propose an innovative calibration framework so that the calibrated simulation model can predict the future outputs for the real system. Our framework can deliver credible intervals for calibration parameters and prediction intervals for future outputs of the real system accounting for the model risk and the system inherent stochastic uncertainty. A new simulation analytics approach is proposed to capture the system dynamic behaviors, which could improve the prediction of system future outputs and provides the comprehensive information of real system working status. Our study will enable the construction of reliable and cost-efficient semiconductor production systems.

- *Statistical Uncertainty Analysis for Stochastic Simulation* (collaborate with Barry L. Nelson and Russell R. Barton) June 2011 – present
 - Supported by National Science Foundation
 - When we use simulation to evaluate the performance of a stochastic system, the simulation often contains input models estimated from real-world data. There are both simulation and input uncertainties in the system performance estimate. To make effective use of the simulation budget, we proposed both frequentist and Bayesian approaches to quantify the overall uncertainty of the system performance estimate. They are supported by rigorous theoretical analysis and demonstrate good finite-sample performance.

- *Marketing Analytics* (collaborate with Edward C. Malthouse) July 2013 – June 2014
 - The emergence of modern information and communication technologies including social media platforms, mobile devices and applications (apps) offers a multiplicity of touch points to engage customers with particular brands. By analyzing customer data from a well-known coalition loyalty program called the Canadian Air Miles Reward Program, we glean insights about how customer engagement through mobile apps affects the customer purchasing behavior. We employ a vector-autoregressive (VAR) model to account for the dynamic interactions among non-purchase customer engagement behaviors (i.e., app usage), purchase and consumption. The information extracted from our study can help marketers adjust their marketing strategy and improve their marketing effectiveness.

- *Approximate Dynamic Programming in Complex Multi-Echelon Inventory and Production Systems* (collaborate with Diego Klabjan) January 2008 – Aug. 2009
 - Supported by National Science Foundation
 - The goal of this project is to study the solution methodologies for general multi-echelon systems with stochastic lead-times, economies of scale, transportation capacities, and demand occurring in each stage of the system. Approximate dynamic programming was used to obtain shipping policies. Since the computation time can increase prohibitively for complex supply chain systems, various parallel algorithms based on Message Passing Interface were proposed to speed up the computation time.

- *Ground Penetrating Radar for Transportation Infrastructure Maintenance* (collaborate with Imad L. Al-Qadi, Douglas L. Jones) August 2005 – Dec.2007
 - Supported by Federal Railroad Administration
 - To provide a fast and reliable evaluation over railroad track substructure system, we used a nondestructive testing method, Ground Penetrating Radar (GPR) with various frequency antennae, to obtain comprehensive information about the ballast thickness, fouling, and the condition of other subsurface layers. To automatically process the ultra-wideband signal collected through GPR, we proposed a data analysis approach based on short-time Fourier transform. On-site samples exhibited reliable and good performance of our approach in assessing railroad track substructure system situation.

- *Damage and Fracture with Peridynamics* (collaborate with Florin Bobaru) August 2003 – June 2005
 - The peridynamic formulation is a novel reformulation of the classical continuous mechanics theory and has strong ties with molecular dynamics models. This method leads to a

meshfree implementation able to successfully model complicated fracture and fragmentation patterns at impact, spallation, etc. To simulate shock waves, the Flux-Corrected Transport technique was implemented in the peridynamic method leading to the Peridynamic Flux-Corrected Transport algorithm. This method can efficiently eliminate the high frequency oscillation behind the shock wave fronts and overcome limitations in the Finite Element Flux-Corrected method.

Technical Publication

Journal Papers

- Xie, W., C. Li, P. Zhang¹ (2017). A Bayesian Nonparametric Hierarchical Framework for Uncertainty Quantification in Simulation, under the second-round review of *Operations Research*.
- Xie, W., C. Li, P. Zhang¹ (2017). A Factor-Based Bayesian Framework for Risk Analysis in Large-Scale Stochastic Simulations, under the second-round review of *ACM Transactions on Modeling and Computer Simulation*.
- Yi, Y.¹, W. Xie (2017). A Metamodel-Assisted Framework for Two-stage Optimization with Stochastic Simulation, submit soon.
- Wang, B.¹, Q. Zhang, W. Xie (2017). Bayesian Sequential Data Collection for Simulation Calibration Using Detailed Sample Paths, submitted.
- Yi, Y.¹, W. Xie (2017). An Efficient Budget Allocation Approach for Quantifying the Impact of Input Uncertainty in Stochastic Simulation, accepted by *ACM Transactions on Modeling and Computer Simulation*.
- Xie, W., B. L. Nelson, R. R. Barton (2016). Multivariate Input Uncertainty in Output Analysis for Stochastic Simulation, *ACM Transactions on Modeling and Computer Simulation*, Vol. 27, Issue 1, No.5.
- Bostanabad, R., A. T. Bui, W. Xie, D. W. Apley, W. Chen (2016). Stochastic Microstructure Characterization and Reconstruction via Supervised Learning. *Acta Materialia*, Vol. 103, pp 89-102.
- Vishvanathan, V., L. Hollebeek, E. Malthouse, E. Mashowska, S. J. Kim, W. Xie (2017). The Dynamics of Consumer Engagement with Mobile Technologies. *Service Science*, Vol. 9, pp 36-49.
- Xie, W., B. L. Nelson, R. R. Barton (2014). A Bayesian Framework for Quantifying Uncertainty in Stochastic Simulation. *Operations Research*, Vol. 62, No. 6, pp. 1439-1452.
- Barton, R. R., B. L. Nelson, W. Xie (2014). Quantifying Input Uncertainty via Simulation Confidence Intervals. *INFORMS Journal on Computing*, Vol. 26, No. 1, pp. 74-87.
- Pei, J., D. Klabjan, W. Xie (2013). Approximations to Auctions of Digital Goods with Share-averse Bidders. *Electronic Commerce Research and Applications*, Vol. 13, No. 2, pp. 128-138.
- Al-Qadi, I.L., W. Xie, R. Roberts (2010). Optimization of Antenna Configuration in Multiple-frequency Ground Penetrating Radar System for Railroad Substructure Assessment. *NDT & E International*, Vol. 43, No. 1, pp. 20-28.

- Al-Qadi, I.L., W. Xie, D.L. Jones, R. Roberts (2010). Development of a Time-Frequency Approach to Quantify Railroad Ballast Fouling Condition Using Ultra-Wide Band Ground-Penetrating Radar Data. *International Journal of Pavement Engineering*, Vol. 11, No. 4, pp.269-279.
- Al-Qadi, I.L., W. Xie, R. Roberts, Z. Leng (2010). Data Analysis Techniques for GPR Used for Assessing Railroad Ballast in High Radio-Frequency Environment, *Journal of Transportation Engineering*, Vol. 136, No. 4, pp.392-399.
- Al-Qadi, I.L., W. Xie, M.A. Elseifi (2008). Frequency Determination from Vehicular Loading Time Pulse to Predict Appropriate Complex Modulus in MEPDG. *Journal of the Association of Asphalt Paving Technologists*, Vol. 77, pp.739-772.
- Al-Qadi, I.L. , W. Xie, R. Roberts (2008). Scattering Analysis of Ground-Penetrating Radar Data to Quantify Railroad Ballast Contamination. *Journal of Nondestructive Testing and Evaluation*, Vol. 41, No. 6, pp.441-447.
- Al-Qadi, I.L. , W. Xie, R. Roberts (2008). Time-Frequency Approach for Ground Penetrating Radar Data Analysis to Assess Railroad Ballast Condition. *Research in Non-destructive Evaluation*, Vol. 19, No. 4, pp.219-237.
- Xie, W., J. Xie (2003). Design of Mechanism Morphology and Mass Distribution for Control. *Machine Design and Research*, Vol. 19, No. 1, pp.31-33. (in Chinese)

Conference and Other Papers

- Xie, W.,P. Zhang¹, Q. Zhang (2017). A Stochastic Simulation Calibration for Real-Time System Control. *Proceedings of the 2017 Winter Simulation Conference*.
- Zhang, Q. and W. Xie (2017). Asymmetric Kriging Emulator For Stochastic Simulation. *Proceedings of the 2017 Winter Simulation Conference*.
- Wang, B.¹, Q. Zhang, W. Xie (2017). Bayesian Sequential Calibration Using Sample Paths. *Proceedings of the 2017 Winter Simulation Conference*.
- Xie, W., Y. Yi¹ (2016). A Simulation-Based Prediction Framework for Two-Stage Dynamic Decision Making. *Proceedings of the 2016 Winter Simulation Conference*.
- Xie, W., C. Li, H. Sun¹ (2015). Quantification Input Uncertainty for Dependent Input Models with Factor Structure. *Proceedings of the 2015 Winter Simulation Conference*.
- Yi, Y.¹, W. Xie, E. Zhou (2015). A Sequential Experiment Design for Input Uncertainty Quantification in Stochastic Simulation. *Proceedings of the 2015 Winter Simulation Conference*.
- Zhou, E., W. Xie (2015). Simulation Optimization when Facing Input Uncertainty. *Proceedings of the 2015 Winter Simulation Conference*.
- Xie, W., B. L. Nelson, R. R. Barton (2014). Statistical Uncertainty Analysis for Stochastic Simulation with Dependent Input Models. *Proceedings of the 2014 Winter Simulation Conference*.
- Xie, W., B. L. Nelson, J. Staum (2010). The Influence of Correlation Functions on Stochastic Kriging Metamodels. *Proceedings of the 2010 Winter Simulation Conference*.
- Barton, R. R., B. L. Nelson, W. Xie (2010). A Framework for Input Uncertainty Analysis. *Proceedings of the 2010 Winter Simulation Conference*.

¹Denotes my Ph.D. students

- Al-Qadi, I.L., R. Roberts, E. Tutumluer, Z. Leng, W. Xie (2009). New Ground Penetrating Radar Analysis Techniques for Ballast Assessment. *Technology Digest* TD-09-028. AAR, TTCI, Pueblo, CO, USA.
- Al-Qadi, I.L. , W. Xie, R. Roberts (2008). Scattering Analysis of Railroad Ballast Using Ground-Penetrating Radar. *Transportation Research Board 86th Annual Meeting*.
- Beak, J., I.L Al-Qadi, W. Xie, W.G. Buttler (2008). In-Situ Assessment of Interlayer Systems to Abate Reflective Cracking in Hot-Mix Asphalt Overlays, *Transportation Research Board (TRB) 87th Annual Meeting*.
- Al-Qadi, I.L., W. Xie, R. Roberts (2007). Flaw Quantification of Railroad Ballast: A New Analysis Approach of Ground Penetrating Radar's Reflection Data, *86th TRB Annual Meetings*. Paper No.07-2273, Washington D.C., Jan 21-25, 2007.
- Popovics, J., N. Ryden, A. Gibson, I.L. Al-Qadi, D.S. Alzate, W. Xie (2007). New Developments in NDE Methods for Pavements. *AIP Conference Proceedings*.
- Xie, W., I.L. Al-Qadi, R. Roberts, E. Tutumluer, J. Boyle (2006). Quantification of Railroad Ballast Condition Using Ground Penetrating Radar Data. *6th International NDE Conference on Civil Engineering*.
- Al-Qadi, I.L. , J.S. Popovics, K. Jiang, W. Xie, G.P. Getrangolo (2006). Structural Assessment of Kingery Bridge Piers Using Combined Nondestructive Testing Methods. *6th International NDE Conference on Civil Engineering*.

Working Papers

- Xie, W., B. L. Nelson, R. R. Barton. Statistical Uncertainty Analysis for Stochastic Simulation, working paper.
- Xie, W., Yi, Y.¹, Z. Zhou. A Dynamic Bayesian Framework to Improve the Reliability of Power Grids with Renewable Energy, working paper.
- Yi, Y.¹, J. Hu, W. Xie. Data-Driven Risk-Averse Stochastic Optimization Integrating Input and Systemic Uncertainties, working paper.
- Xie, W., Q. Zhang, B. Wang ¹. Metamodel-Assisted Risk Analysis with Input Uncertainty for Stochastic Simulation, working paper.
- Akcay, A. E., Gunes Corlu, C., W. Xie. A Survey of Input Uncertainty in Stochastic Simulation, working paper.

Teaching Experience

RENSSELAER POLYTECHNIC INSTITUTE

- Teaching
 - ISYE 4290/6620 Discrete-Event Simulation Modeling Fall 2017
 - ISYE 4210/6600 Design of Manufacturing Systems and Supply Chains Spring 2016,2017
 - ISYE 4140 Statistical Analysis Fall 2014 - Fall 2015

NORTHWESTERN UNIVERSITY

- Co-teaching
 - IMC 451 Statistics and Marketing Research Fall 2013

Work Experience

GENERAL MOTORS

- Summer Intern 2011
 - *Product Content Planning, Packaging and Pricing Project*

The objective of our project is to integrate customer preferences into an optimization framework to identify new vehicle content, packaging alternatives, and prices, to improve program aggregate contribution margin (ACM) and share. The customer preferences that drive the analysis are estimated using clinic data from a choice-based conjoint analysis. There are various sources of uncertainty in estimating the customer preferences. We identified these sources, and proposed different approaches to correctly and effectively propagate the part of estimation error which can be quantified to uncertainty about program ACM and share. This allows us to judge whether the expected performance under a certain decision setting is statistically significantly better than under another setting.

SAN DIEGO SUPERCOMPUTER CENTER

- Summer Intern 2008
 - Supported by *Cyberinfrastructure Experiences for Graduate Students (CIEG) supplement funding*

Proposed and implemented various parallel approaches to find good shipping policies for complex multi-echelon inventory and production systems.

CHENGDU CONSTRUCTION MACHINERY (GROUP) CO.

- Quality Supervisor 1997–1999
 - Control quality on assembly lines
 - Coordinate quality issues across different departments

Presentations

- A Stochastic Simulation Calibration Framework for the Production Control, SRC conference, Piscataway, New Jersey, May 2017
- A Simulation-Based Prediction Framework for Two-Stage Dynamic Decision Making, Winter Simulation Conference, Washington, D.C., December 2016.
- Quantification Input Uncertainty for Dependent Input Models with Factor Structure, Winter Simulation Conference, Huntington Beach, CA, December 2015.
- An Efficient Design of Experiments for Stochastic Simulation: Quantifying Input Uncertainty, INFORMS Annual Meeting, Philadelphia, PA, November 2015.
- Statistical Uncertainty Quantification for Stochastic Simulation with Dependent Input Models, Albany Chapter of the American Statistical Association, Albany, NY, May 2015.
- A Bayesian Framework for Statistical Uncertainty Quantification in Stochastic Simulation, CSE Seminar at Rensselaer Polytechnic Institute, Troy, NY, May 2015.
- Statistical uncertainty analysis for stochastic simulation with dependent input models, Winter Simulation Conference, Savannah, GA, Dec. 2014.

- Multivariate input uncertainty in output analysis for stochastic simulation, INFORMS Annual Meeting, San Francisco, Nov. 2014.
- A Bayesian framework for quantifying uncertainty in stochastic simulation, INFORMS Annual Meeting, San Francisco, Nov. 2014.
- Modeling the effect of engagement and disengagement with mobile apps on customer purchase behavior, Marketing EDGE Professor's Institute, Cincinnati, Jan. 2014.
- Statistical uncertainty analysis for stochastic simulation, INFORMS Annual Meetings, Minneapolis, Oct. 2013.
- The influence of correlation functions on stochastic kriging metamodels, Winter Simulation Conference, Baltimore, Dec. 2010.
- Approximate dynamic programming for serial multi-echelon system with economies of scale, INFORMS Annual Meeting, Washington DC, Oct. 2008.
- Development of a time-frequency approach to quantify railroad ballast fouling condition using UWB GPR data, Transportation Research Board, Washington DC, 2008.
- Scattering analysis of railroad ballast using ground penetrating radar, Transportation Research Board, Washington DC, 2007.
- Quantification of Railroad Ballast Condition Using Ground Penetrating Radar Data, 6th International NDE Conference on Civil Engineering, St. Louis, 2006.

Service and Memberships

Referee

Management Science

Operations Research

European Journal of Operational Research

INFORMS Journal of Computing

ACM Transactions on Modeling and Computer Simulation

Automatica

International Journal of Production Research

Naval Research Logistics

Journal of Simulation

Proceedings of the Winter Simulation Conference

Computers and Operations Research

Member

Institute for Operations Research and The Management Sciences (INFORMS) 2013-present

Transportation Research Board

2006-2007

Internal Professional Activities

Graduate committee

Spring 2017 - present

Undergraduate committee

Fall 2015 - Spring 2016

Undergraduate advisor for 2019 class

Fall 2015 - Spring 2016

Ph.D. thesis committee

- Jie You, Computer System Engineering at RPI, thesis “Cooperative Filtering, Identification, and Mapping for Spatially Distributed Systems Using Mobile Sensor Networks.”
- Hari Prasad, Industrial and Systems Engineering at RPI, thesis “Design of Experiments for Nonlinear Regression Models without using Prior Point Parameter Estimates.”