

# Xun (Ryan) Huan

Assistant Professor  
Mechanical Engineering  
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## RESEARCH INTERESTS

*My research focuses on **uncertainty quantification**, **machine learning**, and **optimization** for engineering applications.*

Optimal Experimental Design • Computational Statistics • Bayesian Statistical Inference • Dimension Reduction • Stochastic Dynamic Programming • Model Misspecification • Data Analytics • Scientific Computing

## EDUCATION

Ph.D.	Aeronautics and Astronautics, Massachusetts Institute of Technology (Major: Computational Science and Engineering; Minor: Law)	2015
S.M.	Aeronautics and Astronautics, Massachusetts Institute of Technology	2010
B.A.Sc.	Engineering Science (Aerospace), University of Toronto	2008

## EMPLOYMENT

<b>University of Michigan</b> , Assistant Professor	Ann Arbor, MI	2018–present
<b>Sandia National Laboratories</b> , Postdoctoral Appointee	Livermore, CA	2016–2018
<b>MIT Uncertainty Quantification Group</b> , Postdoctoral Associate	Cambridge, MA	2015–2016
<b>MIT Uncertainty Quantification Group</b> , Graduate Research Assistant	Cambridge, MA	2008–2015
<b>UToronto Computational Aerodynamics Lab</b> , Summer Research Assistant	Toronto, Canada	2006–2008

## SELECTED AWARDS & HONORS

Top 5 most highly cited papers published in the Journal of Computational Physics 2014–2016 [J11]	2017
MIT Aeronautics and Astronautics Centennial Symposium Presenter [T26]	2014
Natural Sciences and Engineering Research Council of Canada (NSERC) PGS Award	2008–2013
Sandia Summer Institute	2011
BP-MIT Energy Fellowship	2008–2009
Canadian Aeronautics and Space Institute Student Award	2008

## TEACHING EXPERIENCE

<b>ME502</b> (Methods of Differential Equations in Mechanics)	2019 Winter
<b>ME305</b> (Introduction to Finite Elements in Mechanical Engineering)	2018 Fall
<b>MIT 16.90</b> (Computational Methods in Aerospace Engineering), Teaching Assistant	2011 Spring

## PUBLICATIONS

### Journal publications

- [J1] C. Soize, R. Ghanem, C. Safta, **X. Huan**, Z. P. Vane, J. C. Oefelein, G. Lacaze, and H. N. Najm. Enhancing Model Predictability for a Scramjet Using Probabilistic Learning on Manifolds. Published online in *AIAA Journal*, 2018.

- [J2] C. Soize, R. Ghanem, C. Safta, **X. Huan**, Z. P. Vane, J. C. Oefelein, G. Lacaze, H. N. Najm, Q. Tang, and X. Chen. Entropy-based closure for probabilistic learning on manifolds. Accepted in *Journal of Computational Physics*, 2017.
- [J3] P. Tsilifis, **X. Huan**, C. Safta, K. Sargsyan, G. Lacaze, J. C. Oefelein, H. N. Najm, and R. G. Ghanem. Compressive sensing adaptation for polynomial chaos expansions. Accepted in *Journal of Computational Physics*, 2018.
- [J4] D. Vuilleumier, **X. Huan**, T. Casey, M. G. Sjöberg. Uncertainty Assessment of Octane Index Framework for Stoichiometric Knock Limits of Co-Optima Gasoline Fuel Blends. *SAE International Journal of Fuels and Lubricants*, 11(3):247–270, 2018.
- [J5] **X. Huan**, C. Safta, K. Sargsyan, Z. P. Vane, G. Lacaze, J. C. Oefelein, and H. N. Najm. Compressive Sensing with Cross-Validation and Stop-Sampling for Sparse Polynomial Chaos Expansions. *SIAM/ASA Journal on Uncertainty Quantification*, 6(2):907–936, 2018.
- [J6] **X. Huan**, C. Safta, K. Sargsyan, G. Geraci, M. S. Eldred, Z. P. Vane, G. Lacaze, J. C. Oefelein, and H. N. Najm. Global Sensitivity Analysis and Estimation of Model Error, Toward Uncertainty Quantification in Scramjet Computations. *AIAA Journal*, 56(3):1170–1184, 2018.
- [J7] K. Sargsyan, **X. Huan**, and H. N. Najm. Embedded Model Error Representation for Bayesian Model Calibration. Submitted, 2018. arXiv: 1801.06768
- [J8] M. Vohra, **X. Huan**, T. P. Weihs, and O. M. Knio. Design Analysis for Optimal Calibration of Diffusivity in Reactive Multilayers. *Combustion Theory and Modelling*, 21(6): 1023–1049, 2017.
- [J9] **X. Huan** and Y. M. Marzouk. Sequential Bayesian Optimal Experimental Design via Approximate Dynamic Programming. 2016. arXiv: 1604.08320
- [J10] **X. Huan** and Y. M. Marzouk. Gradient-Based Stochastic Optimization Methods in Bayesian Experimental Design. *International Journal for Uncertainty Quantification*, 4(6): 479–510, 2014.
- [J11] **X. Huan** and Y. M. Marzouk. Simulation-Based Optimal Bayesian Experimental Design for Nonlinear Systems. *Journal of Computational Physics*, 232(1): 288–317, 2013.

**Top 5 most highly cited papers published in the Journal of Computational Physics (2014–2016)**

**Conference publications**

- [C1] **X. Huan**, G. Geraci, C. Safta, M. S. Eldred, K. Sargsyan, Z. P. Vane, J. C. Oefelein, and H. N. Najm. Multifidelity Statistical Analysis of Large Eddy Simulations in Scramjet Computations. In *20<sup>th</sup> AIAA Non-Deterministic Approaches Conference*, No. 2018–1180, Kissimmee, FL, 2018.
- [C2] **X. Huan**, C. Safta, K. Sargsyan, G. Geraci, M. S. Eldred, Z. P. Vane, G. Lacaze, J. C. Oefelein, and H. N. Najm. Global Sensitivity Analysis and Quantification of Model Error for Large Eddy Simulation in Scramjet Design. In *19<sup>th</sup> AIAA Non-Deterministic Approaches Conference*, No. 2017–1089, Grapevine, TX, 2017.
- [C3] M. E. Gharamti, Y. M. Marzouk, **X. Huan**, and I. Hoteit. A Greedy Approach for Placement of Subsurface Aquifer Wells in an Ensemble Filtering Framework. In *Dynamic Data-Driven Environment Systems Science, First International Conference, DyDESS 2014*, pages 301–309, Cambridge, MA, 2015.
- [C4] **X. Huan** and Y. M. Marzouk. Optimal Bayesian Experimental Design for Combustion Kinetics. In *49<sup>th</sup> AIAA Aerospace Sciences Meeting*, No. 2011–513, Orlando, FL, 2011.
- [C5] **X. Huan**, J. E. Hicken, and D. W. Zingg. Interface and Boundary Schemes for High-Order Methods. In *19<sup>th</sup> AIAA Computational Fluid Dynamics Conference*, No. 2009–3658, San Antonio, TX, 2009.

**Presentations**

- [T1] Finding the Most Informative Data Using Model-based Bayesian Experimental Design. *Oakland University Department of Physics Colloquium*, Rochester, MI, November 2018.
- [T2] Simulation-based Bayesian Optimal Design for Ice Sheet Borehole Experiments. *Joint Statistical Meetings*, Vancouver, Canada, July–August 2018.
- [T3] Optimal Bayesian Experimental Design of Borehole Locations for Inferring Past Ice Sheet Surface Temperature. *SIAM Annual Meeting*, Portland, OR, July 2018.

- [T4] Simulation-based Bayesian Experimental Design for Computationally Intensive Models. *Isaac Newton Institute for Mathematical Sciences, Programme on Uncertainty Quantification for Complex Systems: Theory and Methodologies; Manchester-Southampton-Glasgow Design of Experiments Seminar Series*, Cambridge, United Kingdom, June 2018.
- [T5] Value of Feedback and Lookahead in Optimal Sequential Bayesian Experimental Design. *Joint Research Conference on Statistics in Quality, Industry, and Technology*, Santa Fe, NM, June 2018.
- [T6] Finding the Most Informative Data Using Model-based Bayesian Experimental Design. *Sandia National Laboratories Dean Seminar*, Livermore, CA, May 2018.
- [T7] Compressive Sensing with Cross-Validation and Stop-Sampling for Sparse Polynomial Chaos Expansions. *SIAM Conference on Uncertainty Quantification*, Garden Grove, CA, April 2018.
- [T8] Optimal Sequential Bayesian Experimental Design. *Santa Fe Institute Workshop: Foresight for Making Good Future Predictions—Lookahead Optimization in Artificial and Natural Systems*, Santa Fe, NM, February 2018.
- [T9] Multifidelity Statistical Analysis of Large Eddy Simulations in Scramjet Computations. *20th AIAA Non-Deterministic Approaches Conference*, Kissimmee, FL, January 2018.
- [T10] Uncertainty Quantification for Flow Simulations Inside a Scramjet Combustor. *Sandia National Labs Combustion Research Facility Research Highlight Series*, Livermore, CA, November 2017.
- [T11] Uncertainty Quantification: Bridging Data and Models. *Sandia National Labs Div8k Data Science Workshop II*, Livermore, CA, September 2017.
- [T12] Global Sensitivity Analysis and Model Error Capturing in Scramjet Computations. *MIT Aerospace Computational Design Laboratory Seminar*, Cambridge, MA, September 2017.
- [T13] Sequential Optimal Experimental Design using Transport Maps. *Joint Statistical Meetings*, Baltimore, MD, July–August 2017.
- [T14] Bayesian Model Calibration with an Embedded Statistical Characterization of Model Error. *14th U.S. National Congress on Computational Mechanics*, Montreal, Canada, July 2017.
- [T15] A Non-Intrusive Embedding Approach for Statistical Characterization of Model Error. *SIAM Annual Meeting*, Pittsburgh, PA, July 2017.
- [T16] Sequential Optimal Experimental Design via Stochastic Control. *SIAM Conference on Control and Its Applications*, Pittsburgh, PA, July 2017.
- [T17] Quantifying Uncertainty from Model Error in Turbulent Combustion Applications. *Sixteenth International Conference on Numerical Combustion*, Orlando, FL, April 2017.
- [T18] Robust Compressive Sensing with Application to Multifidelity Analysis of Complex Turbulent Flows. *SIAM Conference on Computational Science and Engineering*, Atlanta, GA, February–March 2017.
- [T19] Global Sensitivity Analysis and Quantification of Model Error for Large Eddy Simulation in Scramjet Design. *19th AIAA Non-Deterministic Approaches Conference*, Grapevine, TX, January 2017.
- [T20] Global Sensitivity Analysis for Large Eddy Simulation Models. *SIAM Annual Meeting*, Boston, MA, July 2016.
- [T21] Sequential Bayesian Optimal Experimental Design. *International Conference on Design of Experiments*, Memphis, TN, May 2016.
- [T22] Numerical Approaches for Sequential Bayesian Optimal Experimental Design. *SIAM Conference on Uncertainty Quantification*, Lausanne, Switzerland, April 2016.
- [T23] Optimal Sequential Experimental Design using Dynamic Programming and Transport Maps. *8th International Congress on Industrial and Applied Mathematics*, Beijing, China, August 2015.
- [T24] Optimal Sequential Experimental Design using Dynamic Programming and Transport Maps. *13th U.S. National Congress on Computational Mechanics*, San Diego, CA, July 2015.
- [T25] Optimal Sequential Experimental Design. *MIT Aerospace Computational Design Laboratory Seminar*, Cambridge, MA, April 2015.
- [T26] Uncertainty Quantification for Mission Planning. *MIT Aeronautics and Astronautics Centennial Symposium: Student Lightning Talk*, Cambridge, MA, October 2014.
- [T27] Sequential Experimental Design using Dynamic Programming and Optimal Maps. *SIAM Conference on Uncertainty Quantification*, Savannah, GA, April 2014.

- [T28] Optimal Bayesian Sequential Experimental Design using Approximate Dynamic Programming. *INFORMS Annual Meeting, Minneapolis, MN, October 2013.*
- [T29] Optimal Sequential Experimental Design using Gaussian Sum Particle Filtering. *12th U.S. National Congress on Computational Mechanics, Raleigh, NC, July 2013.*
- [T30] Approximate Dynamic Programming for Sequential Bayesian Experimental Design. *SIAM Conference on Computational Science and Engineering, Boston, MA, February–March 2013.*
- [T31] Optimal Sequential Bayesian Experimental Design via Approximate Dynamic Programming. *ISBA World Meeting, Kyoto, Japan, June 2012.*
- [T32] A Dynamic Programming Approach to Sequential and Nonlinear Bayesian Experimental Design. *SIAM Conference on Uncertainty Quantification, Raleigh, NC, April 2012.*
- [T33] Stochastic Optimization Methods in Bayesian Experimental Design. *MIT Computation for Design and Optimization / Center for Computational Engineering Student Symposium, Cambridge, MA, March 2012.*
- [T34] Stochastic Approximation in Simulation-Based Optimal Bayesian Experimental Design.” *7th International Congress on Industrial and Applied Mathematics, Vancouver, Canada, July 2011.*
- [T35] Optimal Experimental Design for Scalar Transport Equations. *20th AIAA Computational Fluid Dynamics Conference, Honolulu, HI, June 2011.*
- [T36] Simulation-Based Optimal Bayesian Experimental Design. *SIAM Conference on Computational Science and Engineering, Reno, NV, February 2011.*
- [T37] Optimal Bayesian Experimental Design for Combustion Kinetics. *49th AIAA Aerospace Sciences Meeting including the New Horizons Forum and Aerospace Exposition, Orlando, FL, January 2011.*
- [T38] Accelerated Bayesian Experimental Design for Chemical Kinetic Models. *MIT Aerospace Computational Design Laboratory Seminar, Cambridge, MA, December 2009.*

### Posters

- [P1] Simulation-based Bayesian Optimal Design for Ice Sheet Borehole Experiments. *Joint Statistical Meetings, Vancouver, Canada, July–August 2018.*
- [P2] Choosing Embedding for Capturing Model Misspecification. *ISBA World Meeting, Edinburgh, United Kingdom, June 2018.*
- [P3] Simulation-Based Optimal Bayesian Design for Sequential Experiments. *Design and Analysis of Experiments, Los Angeles, CA, October 2017.*
- [P4] Approximate Dynamic Programming for Simulation-Based Sequential Optimal Experimental Design. *ISBA World Meeting, Santa Margherita di Pula, Italy, June 2016.*
- [P5] Tractable dynamic programming for optimal sequential experimental design via approximate inference. *ISBA World Meeting, Cancun, Mexico, July 2014.*
- [P6] Dynamic Programming in Sequential Bayesian Experimental Design. *The Institute for Computational and Experimental Research in Mathematics, Providence, RI, October 2012.*
- [P7] Dynamic Programming in Sequential Bayesian Experimental Design. *Uncertainty Quantification Summer School, Los Angeles, CA, August 2012.*
- [P8] Designing the Optimal Experiment via Simulation. *MIT Energy Initiative Fall Research Conference and Energy Fellows Symposium, Cambridge, MA, October 2011.*
- [P9] Optimal Bayesian Experimental Design for Chemical Kinetics. *7th International Conference on Chemical Kinetics, Cambridge, MA, July 2011.*
- [P10] Simulation-Based Optimal Bayesian Experimental Design for Combustion Kinetics. *Workshop on Infusing Statistics and Engineering, Cambridge, MA, June 2011.*
- [P11] Simulation-Based Optimal Bayesian Experimental Design. *Computation for Design and Optimization / Center for Computational Engineering Student Symposium, Cambridge, MA, March 2011.*
- [P12] Optimal Experimental Design Under Uncertainty, with an Application to Reaction Kinetics. *BP Technical Review Meeting, Cambridge, MA, October 2010.*
- [P13] Simulation-Based Optimal Experimental Design with Polynomial Surrogates on Sparse Grids. *Valencia 9 (ISBA World Meeting), Benidorm, Spain, June 2010.*

[P14] Airfoil Design and Optimization Under a Range of Operating Conditions. *Engineering Science Undergraduate Research Day 2007*, Toronto, Canada, August 2007.

## PROFESSIONAL SERVICES

### Conference session organizer

- A. K. Saibaba, J. J.-Mohan, and X. Huan. *Optimal Experimental Design for Inverse Problems*, SIAM Conference on Computational Science and Engineering, Spokane, WA 2019
- X. Huan, D. Woods, and Y. M. Marzouk. *Model-Based Optimal Experimental Design*, SIAM Conference on Uncertainty Quantification, Garden Grove, CA 2018
- K. Sargsyan, X. Huan, and H. N. Najm, *Model Error Quantification in Computational Physical Models*, SIAM Annual Meeting, Pittsburgh, PA 2017
- X. Huan, O. Ghattas, and Y. M. Marzouk, *Bayesian Optimal Experimental Design for ODE/PDE Models*, SIAM Conference on Computational Science and Engineering, Atlanta, GA 2017
- X. Huan, Q. Long, Y. M. Marzouk, and R. F. Tempone, *Advances in Optimal Experimental Design for Physical Models*, SIAM Conference on Uncertainty Quantification, Lausanne, Switzerland 2016
- X. Huan, Q. Long, Y. M. Marzouk, and R. F. Tempone, *Advances in Optimal Experimental Design*, the 8<sup>th</sup> International Congress on Industrial and Applied Mathematics (ICIAM), Beijing, China 2015
- X. Huan, Y. M. Marzouk, L. Tenorio, G. Terejanu, *Advances in Optimal Experimental Design*, SIAM Conference on Uncertainty Quantification, Savannah, GA 2014

### Journal referee

Advances in Water Resources • AIAA Journal • Bayesian Analysis • Cancer Informatics • CEAS Aeronautical Journal • Computational Statistics & Data Analysis • Computer Methods in Applied Mechanics and Engineering • Expert Systems With Applications • IEEE Signal Processing Letters • IEEE Transactions on Aerospace and Electronic Systems • International Journal for Uncertainty Quantification • International Journal of Heat and Mass Transfer • Mathematical and Computational Applications • Operations Research • Sensors • SIAM Journal on Scientific Computing • SIAM/ASA Journal on Uncertainty Quantification

### Professional societies

Society for Industrial and Applied Mathematics (SIAM) • American Institute of Aeronautics and Astronautics (AIAA) • International Society for Bayesian Analysis (ISBA) • American Geophysical Union (AGU)