SAFETY ENGINEERING & RISK ANALYSIS DIVISION

Division Newsletter
Volume 10, Third Quarter

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Highlights

Featured ASCE-ASME Journal Papers; Four recent award-winning articles from the ASCE-ASME Journal.

Research News; Recent activities at the University of Illinois SoTeRiA Lab

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Chair's Message

Dear SERAD Members,

Welcome SERAD members! Because Covid-19 Delta Variant surges, Covid-19 Pandemic is far from over. As a member of the SERAD community, we hope you talk with your family, friends, and colleagues to be vaccinated and to follow the CDC Covid guidelines because these are the best approaches to reduce the risk and to be safe.

Since July 2021, I have assumed the chair position of the ASME Safety Engineering and Risk Analysis Division. We are currently working on the SERAD division strategic plan. The division's strategic plan is dynamic and will be continuously discussed and modified annually. If you have any suggestions, please contact us for creating a feasible and practical strategic plan for the SERAD division.

The SERAD division proudly sponsored Dr. Bilal Ayyub's TEC talk on August 26, 2021. The TEC talk title is "Hazard-Resilient Infrastructure: Systems and Networks". Dr. Bilal Ayyub is a professor of A James Clark School of Engineering and the director of the University of Maryland Center for Technology and Systems Management. This presentation introduced analysis and design methods for hazard-resilient infrastructure. f you have a topic from which mechanical engineers can be benefited and want to disseminate it, please contact us. We could sponsor you as a TEC talk. The TEC talk is typically a one-hour online presentation including around 40 minutes presentation and 15 minutes of Q&A.

The SERAD division organizes and sponsors Track 14: Safety Engineering, Risk and Reliability Analysis in the IMECE2021 (International Mechanical Engineering Congress & Exposition) conference during November 1-5, 2021. This will have networking opportunities and a wealth of presentations. Since it is a virtual online conference, we hope to see you during the conference.

The SERAD division has formed a new "Award and Fellowship committee" chaired by Dr. Mohammad Pourgol-Mohammad. If you have reached the requirement for promoting to ASME Fellow, you can contact us and our committee will help you.

Mr. Ernie Kee has made significant contributions to the SEARD newsletter and agreed to continuously volunteer as the newsletter editor for the physical year 2021-2022. The ASME SEARD division is formed by volunteers and has a monthly one-hour online virtual meeting and a lot of activities. The primary objective of this committee is to serve the ASME Safety engineering and Risk analysis community. If you want to volunteer to join our division monthly meeting and our activities, please contact us.

Best Regards;

Xiaobin Le, Ph.D., PE
ASME SERAD Chair, 2021-2022

Probabilistic Risk Assessment @ University of Illinois: 2021 Features

The Socio-Technical Risk Analysis (SoTeRiA) Research Laboratory, directed by Associate Professor Zahra Mohaghegh, in the Department of Nuclear, Plasma and Radiological Engineering at the University of Illinois at Urbana-Champaign, advances Probabilistic Risk Assessment (PRA) science and applications for complex technological systems. SoTeRiA has been making scholarly contributions to PRA and bridging foundational PRA research with nuclear industry and regulatory needs, benefitting from grants awarded by the Department of Energy (DOE), the National Science Foundation (NSF), the Nuclear Regulatory Commission (NRC), the nuclear industry, and the International Atomic Energy Agency (IAEA).

Recent research news about SoTeRiA include:

1. SoTeRiA Laboratory received two grant awards from the U.S Nuclear Regulatory Commission (NRC) and Department of Energy (DOE) to advance PRA:
   (a) Advancing Uncertainty Analysis Processes in Risk-Informed Regulatory Framework to Support Simulation Approaches for Aging Plants and Advanced Reactors [from NRC]
   (b) Probabilistic Validation and Risk Importance Ranking Methodology for Automation Trustworthiness and Transparency in Nuclear Power Plants [from DOE]
2. Professor Zahra Mohaghegh was featured in the "Leaders" section for September issue of Nuclear News magazine from the American Nuclear Society. Her article, "Lighting the Path for Next-Generation PRA Leaders in Nuclear Engineering," highlights Probabilistic Risk Assessment (PRA) educational and research gaps and proposes urgent actions to be taken by academia and government agencies to prepare next-generation PRA leaders for achieving short- and long-term nuclear energy goals.
3. Professor Zahra Mohaghegh has been selected to serve as a member of a Committee on "Transport Airplane Risk Assessment Methodology" of the U.S. National Academies of Sciences, Engineering, and Medicine. This study will assess the risk assessment methodology used by the Federal Aviation Administration (FAA) under the overall safety oversight system. FAA uses the Transport Airplane Risk Assessment Methodology (TARAM) to quantify potential risks in currently operating airplanes and to inform FAA decision makers regarding corrective actions to prevent accidents.
4. SoTeRiA laboratory published the final report on a research project awarded by the DOE Nuclear Energy University Program (NEUP):

   Mohaghegh, Z., Sakurahara, T., Beal, J., Cheng, W.C., Farshadmanesh, P., Reihani, S., Kee, E., Rowell, A. and Yilmaz, F., 2021. *Systematic Enterprise Risk Management by Integrating the RISMC Toolkit and Cost-Benefit Analysis*. United States: N. p., 2021. Web. doi:10.2172/1817917.
   https://www.osti.gov/biblio/1817917-systematic-enterprise-risk-management-integrating-rismc-toolkit-cost-benefit-analysis-final-report

Algorithmic Optimization using High Performance Computing with Potential Risk and Reliability Application

Arun Veeramany, Senior Scientist
Earth Systems Predictability and Resilience, Pacific Northwest National Laboratory (PNNL), Richland WA

Abstract from a Recent Talk given at Texas Tech

In Power Systems, the Unit Commitment (UC) problem determines which generators to turn on or off in the system and when to do so while minimizing production cost. Security Constraints (SC) refer to the set of the rules of physics that the Unit Commitment problem should satisfy on the power grid. Together, SCUC determines the generator schedule on the market. This is a combinatorial problem and difficult to solve within an acceptable time limit even without adding large amount of renewables to the electricity generation mix. In the scheduling process, applied operations research enables determination of day- ahead and hour-ahead electricity generation schedules. The industry presently follows a time-restrictive procedure for resource planning using operations research that does not take into consideration several mathematical formulations and topological configuration possibilities. These possibilities include combinatorics of electricity generators and potential loss of transmission assets at the time of dispatch. In a paradigm shift, the ARPA-E

High Performance Power Grid Optimization (HIPPO) project helped grid operators manage increasingly dynamic and distributed energy resource portfolio by executing complex calculations up to 35 times faster. This foundation for integration and dispatch of renewables into the power grid was made possible with collaborative advances in operations research, high performance computing, data sciences, and power system engineering. The talk will describe the journey undertaken by the research team and in particular, the Concurrent Optimizer, a critical component of HIPPO that made the project a commercial success.

Author Biography

Arun Veeramany is a Senior Scientist specializing in risk, reliability and resilience of engineered systems at the Pacific Northwest National Laboratory with a Ph.D. in reliability of nuclear power plant systems. Dr. Veeramany is serving as a task manager for Power Grid Optimization (GO) Competition, the architect of Schedule Visualizer - a project schedule comparison tool, and as a data scientist for prognostic health management of oil and gas transmission pipelines. Dr. Veeramany is currently serving on the Executive Committee of the ASME Safety Engineering and Risk Analysis Division (SERAD) as well as a Guest Editor for ASCE-ASME Journal of Risk and Uncertainty in Engineering.

ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems
More Information: https://ascelibrary.org/journal/ajrub7 Contact Prof. Bilal M. Ayyub, Editor in Chief, ba@umd.edu

The Application of Downhole Vibration Factor in Drilling Tool Reliability Big Data Analytics–A Review

Yali Ren, Ning Wang, Jinwei Jiang, Junxiao Zhu, Gangbing Song, and Xuemin Chen
ASME J. Risk Uncertainty Part B. March 2019; 5(1): 010801. https://doi.org/10.1115/1.4040407

Most Read Paper

Abstract

In the challenging downhole environment, drilling tools are normally subject to high temperature, severe vibration, and other harsh operation conditions. The drilling activities generate massive field data, namely field reliability big data (FRBD), which includes downhole operation, environment, failure, degradation, and dynamic data. Field reliability big data has large size, high variety, and extreme complexity. FRBD presents abundant opportunities and great challenges for drilling tool reliability analytics. Consequently, as one of the key factors to affect drilling tool reliability, the downhole vibration factor plays an essential role in the reliability analytics based on FRBD. This paper reviews the important parameters of downhole drilling operations, examines the mode, physical and reliability impact of downhole vibration, and presents the features of reliability big data analytics. Specifically, this paper explores the application of vibration factor in reliability big data analytics covering tool lifetime/failure prediction, prognostics/diagnostics, condition monitoring (CM), and maintenance planning and optimization. Furthermore, the authors highlight the future research about how to better apply the downhole vibration factor in reliability big data analytics to further improve tool reliability and optimize maintenance planning.

Structural Life Expectancy of Marine Vessels: Ultimate Strength, Corrosion, Fatigue, Fracture, and Systems

Bilal M. Ayyub, Karl A. Stambaugh, Timothy A. McAllister, Gilberto F. de Souza, and David Webb
ASME J. Risk Uncertainty Part B. March 2015; 1(1): 011001. https://doi.org/10.1115/1.4026396

Most cited paper

Abstract

This paper provides a methodology for the structural reliability analysis of marine vessels based on failure modes of their hull girders, stiffened panels including buckling, fatigue, and fracture and corresponding life predictions at the component and system levels. Factors affecting structural integrity such as operational environment and structural response entail uncertainties requiring the use of probabilistic methods to estimate reliabilities associated with various alternatives being considered for design, maintenance, and repair. Variability of corrosion experienced on marine vessels is a specific example of factors affecting structural integrity requiring probabilistic methods. The Structural Life

Assessment of Ship Hulls (SLASH) methodology developed in this paper produces time-dependent reliability functions for hull girders, stiffened panels, fatigue details, and fracture at the component and system levels. The methodology was implemented as a web-enabled, cloud-computing-based tool with a database for managing vessels analyzed with associated stations, components, details, and results, and users. Innovative numerical and simulation methods were developed for reliability predictions with the use of conditional expectation. Examples are provided to illustrate the computations.

Optimizing Predictive Maintenance With Machine Learning for Reliability Improvement

Yali Ren

ASME J. Risk Uncertainty Part B. September 2021; 7(3): 030801. https://doi.org/10.1115/1.4049525

Review article

Abstract

Predictive maintenance, as a form of pro-active maintenance, has increasing usage and shows significant superiority over the corrective and preventive maintenance. However, conventional methods of predictive maintenance have noteworthy limitations in maintenance optimization and reliability improvement. In the last two decades, machine learning has flourished and overcome many inherent flaws of conventional maintenance prediction methods. Meanwhile, machine learning displays unprecedented predictive power in maintenance prediction and optimization. This paper compares the features of corrective, preventive, and predictive maintenance, examines the conventional approaches to predictive maintenance, and analyzes their drawbacks. Subsequently, this paper explores the driving forces, and advantages of machine learning over conventional solutions in predictive maintenance. Specifically, this paper reviews popular supervised learning and reinforcement learning algorithms and the associated typical applications in predictive maintenance. Furthermore, this paper summarizes the four critical steps of machine learning applications in maintenance prediction. Finally, the author proposes future research concerning how to utilize machine learning to optimize maintenance prediction and planning, improve equipment reliability, and achieve the best possible benefit.

Uncertainty Quantification for Fatigue Life of Offshore Wind Turbine Structure

Abraham Nispel, Stephen Ekwaro-Osire, João Paulo Dias, Americo Cunha, Jr.

ASME J. Risk Uncertainty Part B. December 2021; 7(4): 040901. https://doi.org/10.1115/1.4051162

Abstract

This study aims to address the question: can the structural reliability of an offshore wind turbine (OWT) under fatigue loading conditions be predicted more consistently? To respond to that question this study addresses the following specific aims: (1) to obtain a systematic approach that takes into consideration the amount of information available for the uncertainty modeling of the model input parameters and (2) to determine the impact of the most sensitive input parameters on the structural reliability of the OWT through a surrogate model. First, a coupled model to determine the fatigue life of the support structure considering the soil-structure interaction under 15 different loading conditions was developed. Second, a sensitivity scheme using two global analyses was developed to consistently establish the most and least important input parameters of the model. Third, systematic uncertainty quantification (UQ) scheme was employed to model the uncertainties of model input parameters based on their available–data-driven and physics-informed–information. Finally, the impact of the proposed UQ framework on the OWT structural reliability was evaluated through the estimation of the probability of failure of the structure based on the fatigue limit state design criterion. The results show high sensitivity for the wind speed and moderate sensitivity for parameters usually considered as deterministic values in design standards. Additionally, it is shown that applying systematic UQ not only produces a more efficient and better approximation of the fatigue life under uncertainty, but also a more accurate estimation of the structural reliability of offshore wind turbine's structure during conceptual design. Consequently, more reliable, and robust estimations of the structural designs for large offshore wind turbines with limited information may be achieved during the early stages of design.

ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems
More Information: https://ascelibrary.org/journal/ajrub7 Contact Prof. Bilal M. Ayyub, Editor in Chief, ba@umd.edu

ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part A: Civil Engineering, Part B: Mechanical Engineering

Alba Sofi, PhD

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Established in 2014 by the current Editor-in-Chief, Professor Bilal M. Ayyub from the University of Maryland College Park, the ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part A: Civil Engineering and Part B: Mechanical Engineering serves as a medium for dissemination of research findings, best practices and concerns, and for discussion and debate on risk and uncertainty-related issues in the areas of civil and mechanical engineering and other related fields. The journal addresses risk and uncertainty issues in planning, design, analysis, construction/manufacturing, operation, utilization, and life-cycle management of existing and new engineering systems.

Both Part A and Part B are listed in the Emerging Citation Sources by Clarivate Analytics, formerly Thomson Reuters, and are eligible for indexing in 2018. From 2016 onward, all articles will be included in Web of Science. They are also included in Scopus.

Part A has successfully secured an impact factor of 1.331 based on the latest Journal Citation Reports by Clarivate Analytics.

Journal of Risk and Uncertainty contents

Issue	Latest Issues & (Issue Date)		
Part A	Volume 7-Issue 4 (December 2021)		
Part A	Volume 7-Issue 3 (September 2021)	Part B	Volume 8-Issue 3 (September 2022, In progress)
Part A	Volume 7-Issue 2 (June 2021)	Part B	Volume 8-Issue 2 (June 2022, In progress)
Part A	Volume 7-Issue 1 (March 2021)	Part B	Volume 8-Issue 1 (March 2022, In progress)
	2020 Table of Contents		
Part A	Volume 6-Issue 4 (December 2020)	Part B	Volume 7-Issue 4 (December 2021, In progress)
Part A	Volume 6-Issue 3 (September 2020)	Part B	Volume 7-Issue 3 (September 2021)
Part A	Volume 6-Issue 2 (June 2020)	Part B	Volume 7-Issue 2 (June 2021) (June 2020)
Part A	Volume 6-Issue 1 (March 2020)	Part B	Volume 7-Issue 1 (March 2021) (March 2020)

Latest State of the Art Reviews: Part A

"Time-Dependent Reliability of Aging Structures: Overview of Assessment Methods" by Cao Wang, Michael Beer, Bilal M. Ayyub

"Structural System Reliability: Overview of Theories and Applications to Optimization" by Junho Song, Won-Hee Kang, Young-Joo Lee, Junho Chun

"Probabilistic Inference for Structural Health Monitoring: New Modes of Learning from Data" by Lawrence A. Bull, Paul Gardner, Timothy J. Rogers, Elizabeth J. Cross

"Scale of Fluctuation for Spatially Varying Soils: Estimation Methods and Values" by Brigid Cami, Sina Javankhoshdel, Kok-Kwang Phoon, and Jianye Ching

"Social Indicators to Inform Community Evacuation Modeling and Planning" by William Seites-Rundlett, Elena Garcia-Bande, Alejandra Álvarez-Mingo, Cristina Torres-Machi, and Ross B. Corotis

"Assessment Methods of Network Resilience for Cyber-Human-Physical Systems" by Sisi Duan and Bilal M. Ayyub

Latest Review Articles: Part B

"Optimizing Predictive Maintenance With Machine Learning for Reliability Improvement" by Yali Ren

"Path Integral Methods for the Probabilistic Analysis of Nonlinear Systems Under a White-Noise Process" by Mario Di Paola and Gioacchino Alotta

"Sensemaking in Critical Situations and in Relation to Resilience - A Review" by Stine S. Kilskar, Brit-Eli Danielsen, Stig O. Johnsen

Latest Special Collections: Part A

"Special Collection on Bayesian Learning Methods for Geotechnical Data" Ka-Veng Yuen, Jianye Ching, Kok Kwang Phoon

"Special Collection on Resilience Quantification and Modeling for Decision Making" Gian Paolo Cimellaro and Nii O. Attoh-Okine

Latest Special Issues And Special Sections: Part B

"Special Section: Special Section on Risk and Uncertainties in Offshore Wind and Wave Energy Systems" by Vikram Pakrashi, Jimmy Murphy, Budhaditya Hazra

"Special Section: Nonprobabilistic and Hybrid Approaches for Uncertainty Quantification and Reliability Analysis" by Matthias G. R. Faes, David Moens, Michael Beer, Hao Zhang, Kok-Kwang Phoon

"Special Section on Response Analysis and Optimization of Dynamic Energy Harvesting Systems in Presence of Uncertainties" by Agathoklis Giaralis, Ioannis A. Kougioumtzoglou, Pol D. Spanos

"Special Section on Uncertainty Management in Complex Multiphysics Structural Dynamics" by Sifeng Bi, Michael Beer, Morvan Ouisse, Scott Cogan

"Special Section on Resilience of Engineering Systems" by Geng Feng, Michael Beer, Frank P. A. Coolen, Bilal M. Ayyub, Kok-Kwang Phoon

"Special Issue on Human Performance and Decision-Making in Complex Industrial Environments" by Raphael Moura, Michael Beer, Luca Podofillini

Recognitions & Awards

Recognitions for Papers

	Part A
Editor's Choice Paper	"Sustainable Building Construction: Tension between Material Efficiency and Earthquake Risk" by Regine Ortlepp and Azeraksh Rawan
Most Read Paper	"Climate Impact Risks and Climate Adaptation Engineering for Built Infrastructure" by Mark G. Stewart and Xiaoli Deng
Most Cited Paper	"Resilience Assessment of Urban Communities" by Omar Kammouh, Ali Zamani Noori, Gian Paolo Cimellaro, Stephen A. Mahin
Editor's Choice Collection	For each issue of the journal, the Chief Editor may select a paper to be featured on the journal homepage in the ASCE Library. The paper is available for free to registered users for 1 to 4 months, depending on how frequently the journal is published. A list of Editor's Choice selections is available here.
	Part B
Most Read Paper	"The Application of Downhole Vibration Factor in Drilling Tool Reliability Big Data Analytics–A Review" by Yali Ren, Ning Wang, Jinwei Jiang, Junxiao Zhu, Gangbing Song, Xuemin Chen
Most Cited Paper	"Structural Life Expectancy of Marine Vessels: Ultimate Strength, Corrosion, Fatigue, Fracture, and Systems" by Bilal M. Ayyub, Karl A. Stambaugh, Timothy A. McAllister, Gilberto F. de Souza, David Web
Featured Article	"The Application of Downhole Vibration Factor in Drilling Tool Reliability Big Data Analytics–A Review" by Yali Ren, Ning Wang, Jinwei Jiang, Junxiao Zhu, Gangbing Song, Xuemin Chen

Outstanding Reviewers

Part A 2020 Outstanding Reviewers	Part B 2020 Reviewers of the Year
Byron Tyrone Adey	Edoardo Patelli, *University of Strathclyde, UK*
Michele Barbato	Ketson dos Santos, *Columbia University, USA*
André T. Beck	
Michael Beer	
Michele Betti	
Shui-Hua Jiang	
Samuel Labi	
Edoardo Patelli	
Alba Sofi	
Cao Wang	

Best Paper Award

Starting in 2019, the Best Paper Award will be given annually to one paper in Part A and one paper in Part B appearing in the preceding volume year. Papers are evaluated by the Editorial Board members based on the following criteria:

- fundamental significance
- potential impact
- practical relevance to industry
- intellectual depth
- presentation quality.

2020 Part A Recipients
Authors: Yue Hu, Yu Wang, Tengyuan Zhao, and Kok-Kwang Phoon
Title: "Bayesian Supervised Learning of Site-Specific Geotechnical Spatial Variability from Sparse Measurements"

2020 Part B Recipients
Authors: Alba Sofi, Giuseppe Muscolino, and Filippo Giunta
Title: "A Sensitivity-Based Approach for Reliability Analysis of Randomly Excited Structures With Interval Axial Stiffness"

The award for the Best Paper published in 2020 in Part A and Part B will be presented to the authors in attendance at the ASME Safety Engineering and Risk Analysis Division (SERAD) award ceremony at the International Mechanical Engineering Congress & Exposition (IMECE), Virtual Conference, which will be held online during the period November 1–5, https://event.asme.org/IMECE.

ASCE and ASME post the winning paper's information on the journal website as well as on social media. The winning papers are made freely available from the ASCE Library (Part A) and from the ASME Digital Collection (Part B) for one year to anyone interested once registered and logged in to download. Moreover, ASME offers the authors a one-year free subscription to Part B.

Social media (Twitter and LinkedIn)

The ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems in its two parts is now also active on Social Media. Follow our pages on Twitter and LinkedIn:

 Twitter: ASCE-ASME Journal of Risk and Uncertainty

 LinkedIn: ASCE-ASME Journal of Risk and Uncertainty

 https://chinahow.guide/wechat-registration-sign-up/ 

to stay up-to-date on latest issues, highlighted journal content, active calls for special issues and special collections, recognitions and awards.

Journal's Newsletter

The Journal's Newsletter is sent out on a quarterly basis. To receive updates on the Journal's progress and announcements, subscribe to the Newsletter here: Subscribe to the Journal Newsletter

Calls for Papers

Submission

Part A: Submit to Part A here

Part B: Submit to Part B here

State-of-the-Art Reviews (Part A) and Review Articles (Part B) on topics of current interest in the field of risk and uncertainty are especially welcome.

Please contact the Editor or Managing Editors by email if you are interested in guest editing a Special Collection (Part A) or a Special Issue (Part B).

Practical Observations on Safety

This quarter, the Wearout editorial is delivered as a multi-media presentation. You should be able to “click” on the picture of a presentation’s title page, “Practical Observations on Safety”.

What are your thoughts and feedback? Let’s talk!
Ernie Kee, SERAD Editor
Send your feedback/thoughts on this or any reliability subject to me at erniekee@illinois.edu.

SERAD Committee

Table 1. 2021–2022 SERAD Committee Membership

Executive Committee		Appointments	
Position	Person	Position	Person
Chair	Xiaobin Le, lex@wit.edu	**Nominating Chair**	Mohammad Pourgol-Mohammad
1st Vice-Chair	Arun Veeramany, arun.veeramany@pnnl.gov	**Award Chairs**	Jeremy Gernand, jmg64@psu.edu John Weichel, jwiechel@sealimited.com
2nd Vice-Chair-Treasurer	Stephen Ekwaro-Osire, Stephen.Ekwaro-Osire@ttu.edu	**Newsletter Editor**	Ernie Kee, erniekee@illinois.edu
3rd Vice Chair-Membership	Mihai Diaconeasa madiacon@ncsu.edu	**Webinars / Outreach Chair**	Open
4th Vice-Chair-Secretary	Andrey Morozov, andrey.morozov@tu-dresden.de	**Student Program Coordinator**	Deivi Garcia, deivi.garciagarzon@gmail.com
Past Chair	Mohammad Pourgol-Mohammad, pourgol-mohamadm2@asme.org	**Technical Content Coordinator**	Giulio Malinverno, giulio.malinverno@gmail.com
MECE 2021 Track Organizers	Andrey Morozov Ernie Kee Bill Munsell, bmunsell@att.net Mihai Diaconeasa		