SAFETY ENGINEERING
& RISK ANALYSIS
DIVISION

Division Newsletter
Volume 12, First Quarter

In This Issue

Highlights

Research News; Recent activities at HazTechRisk.org

Journal News
Updates on the most recent contents and award-winning articles in the ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems

Call for Papers
Submit your new research and findings to Part A and Part B journal sections

Featured ASCE-ASME Journal Papers; Two recent selected articles from the ASCE-ASME Journal in focus–Most read and a Review article

Editorial Page
Comments on difficulties with current approaches to accurately quantifying probabilities of future failures in robust protective systems

Chair's Message

Dear SERAD Members,

We hope you are all well and healthy. There is good news for the ASME International Mechanical Engineering Congress & Exposition (IMECE2022 conference). After two virtual conferences in 2022 and 2021 due to the COVID-19 pandemic, the IMECE 2022 conference will be an in-person conference, in Columbus, OH, October 30-November 3, 2022. The Safety Engineering, Risk, and Reliability Analysis Division (SERAD) continuously sponsors Track 14 in the IMECE2022 conference: Safety Engineering, Risk and Reliability Analysis. This conference will cover a variety of different topics and will certainly have some topics that you will be interested in. Please mark your calendar and we hope to see you at this coming conference and to meet with your colleague and friends. For more information, please check the IMECE 2022 conference website.

SERAD continuously hosts a 2022 student paper on the safety innovation challenge contest. Undergraduate and graduate students working in the field of safety, risks, and reliability analysis are encouraged to work with your advisors for submitting their research papers. Winners of the undergraduate group and the graduate student groups will receive SEARD awards with cash rewards. For detailed information, please check the flyer published in this newsletter. We sincerely appreciate FM Global which has sponsored this student challenge contest for several years and continuously sponsors the 2022 student paper on safety innovation challenge contest. Since this is a great opportunity to engage young career engineers in SERAD, this activity is very important. We hope more organizations could sponsor this activity and make it more successful. If your organizations could sponsor this activity, please contact us and we appreciate your support. This year, we will hold our in-person award ceremony in a restaurant with wonderful presentations and delicious foods during the IMECE 2022 conference.

As you know, the SERAD consists of all volunteers and serves SREAD members. Your volunteers are the guarantee of SERAD's success. The Executive committee has 5 members including a chair, 1st vice-chair (ESS Liaison), 2nd vice-chair (Treasurer), 3rd vice-chair (Membership), and 4th vice-chair (Secretary). Now, we have a new position for the 4th vice-chair (Secretary) for the 2022-2023 year. The person in this position will have a 5-years commitment to SERAD and will take a new position every year from 4th vice-chair to chair of the division. If you are interested, please volunteer your service to SERAD. A detailed message about the application will be sent out soon.

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

Research News

HazTechRisk.org has been researching certain assumptions required in Probabilistic Quantification (PQ) methodologies and their impact on decision-making in regulation where PQ is used. A recent preprint article titled "Probability Quantification and Regulatory Risk Assessment" accessible at arXiv summarizes some of the consequences to protective system risk assessments conducted using PQ. An example is risk assessments conducted on robust protective systems such as Probabilistic Risk Assessment (PRA).

Probability Quantification and Regulatory Risk Assessment

A preprint article in arXiv (arXiv:2203.04315)

Martin Wortman, PhD, PhD, Ernie Kee, Pranav Kannan, PhD

Probabilistic Quantification (PQ) predictions of the efficacy of safety-critical protective systems is challenging. Yet, the popularity of PQ methodologies (e.g., Probabilistic Risk Assessment (PRA), Quantitative Risk Analysis (QRA) and Probabilistic Safety Analysis (PSA)) is growing and can now be found written into regulatory rules. PQ in predictive modeling is attractive because of its grounding in probability theory. But, certain important safety related events are not probability-measurable which is problematic for risk-analytic methodologies that rely on PQ computations. Herein, we identify why the dynamics of available information play an essential role in governing the fidelity of PQ and why PQ in the analysis of safety-critical protective systems is limited by the un-measurability of certain critical events. We provide an historical example that provides a practical context for our observations. Finally we discuss the implications of measurability for regulatory decision-making governed by recent nuclear industry legislation advocating increased use of risk informed, performance-based regulation for advanced reactor licensing.

Keywords Probability Quantification, Filtration, Failure Modes, Stopping Times

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

University "Mediterranea" of Reggio Calabria, Italy, e-mail: alba.sofi@unirc.it

Established in 2014 by 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.

The current Editor-in-Chief is the Founding Associate Editor, Professor Michael Beer, from Leibniz Universität Hannover.

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 1.926 based on the latest Journal Citation Reports by Clarivate Analytics.

Journal of Risk and Uncertainty contents

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

Latest State of the Art Reviews: Part A

"Resilience-Based Design of Infrastructure: Review of Models, Methodologies, and Computational Tools Resilience-Based Design of Infrastructure: Review of Models, Methodologies, and Computational Tools" by Mahdi Shadabfar, Mojtaba Mahsuli, Yi Zhang, Yadong Xue, Bilal M. Ayyub, Hongwei Huang and Ricardo A. Medina

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

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

"Emerging Technologies for Resilient Infrastructure: Conspectus and Roadmap" by Mahmoud Reda Taha, Bilal M. Ayyub, Kenichi Soga, and Sherif Daghash

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

Latest Review Articles: Part B

"Prognostics and Health Management of Wind Energy Infrastructure Systems", by Celalettin Yüce, Ozhan Gecgel, Oğuz Doğan, Shweta Dabetwar, Yasar Yanik, Onur Can Kalay, Esin Karpat, Fatih Karpat, Stephen Ekwaro-Osire

"Uncertainty Quantification for Additive Manufacturing Process Improvement: Recent Advances", by Sankaran Mahadevan, Paromita Nath, Zhen Hu

"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, and Stig O. Johnsen

Latest Special Collections: Part A

"Special Collection on Bayesian Learning Methods for Geotechnical Data" Ka-Veng Yuen, Jianye Ching, and 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 on Probabilistic Approaches for Robust Structural Health Monitoring of Wind Energy Infrastructure"

"Special Issue on Uncertainty Quantification and Management in Additive Manufacturing" Zhen Hu, Saideep Nannapaneni, and Sankaran Mahadevan

"Special Section on Risk and Uncertainties in Offshore Wind and Wave Energy Systems" Vikram Pakrashi, Jimmy Murphy, and 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, and Kok-Kwang Phoon

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

Recognitions & Awards

Recognitions for Papers

	Part A
Editor's Choice Paper	"Data Normalization and Anomaly Detection in a Steel Plate-Girder Bridge Using LSTM", by Wen-Jie Jiang, Chul-Woo Kim, Yoshinao Goi, Feng-Liang Zhang
Most Read Paper	"Climate Impact Risks and Climate Adaptation Engineering for Built Infrastructure" by Mark G. Stewart and Xiaoli Deng
Most Cited Paper	"Scale of Fluctuation for Spatially Varying Soils: Estimation Methods and Values"' by Brigid Cami, Sina Javankhoshdel, Kok-Kwang Phoon, and Jianye Ching
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	"Prognostics and Health Management of Wind Energy Infrastructure Systems", Celalettin Yüce, Ozhan Gecgel, Oğuz Doğan, Shweta Dabetwar, Yasar Yanik, Onur Can Kalay, Esin Karpat, Fatih Karpat, Stephen Ekwaro-Osire
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	"Resilience Decision-Making for Complex Systems", by Julian Salomon, Matteo Broggi, Sebastian Kruse, Stefan Weber, Michael Beer

Outstanding Reviewers

Part A 2020 Outstanding Reviewers	Part B 2021 Reviewers of the Year
Byron Tyrone Adey	Chen Jiang, *Huazhong University of Science and Technology, China*
Michele Barbato	Imad Abdallah, *Eidgenössische Technische Hochschule Zürich, Switzerland*
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.

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.

The award is typically presented to the authors in attendance at the ASME Safety Engineering and Risk Analysis Division (SERAD) award reception meeting at the annual International Mechanical Engineering Congress & Exposition (IMECE).

The selection process for the 2021 Best Paper Award is in progress.

Part A: active Calls for Special Collections

Special Collection on "Special Collection on Benchmarking Data-driven Site Characterization Methods" (SC052A). Paper submission deadline: August 1, 2022.

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.

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).

Featured ASCE-ASME Journal Papers Part B: Mechanical 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

Prognostics and Health Management of Wind Energy Infrastructure Systems

Celalettin Yüce, Ozhan Gecgel, Oğuz Doğan, Shweta Dabetwar, Yasar Yanik, Onur Can Kalay, Esin Karpat, Fatih Karpat, Stephen Ekwaro-Osire

ASME J. Risk Uncertainty Part B. Jun 2022, 8(2): 020801.

Review article; Most read paper

Abstract

The improvements in wind energy infrastructure have been a constant process throughout many decades. There are new advancements in technology that can further contribute toward the prognostics and health management (PHM) in this industry. These advancements are driven by the need to fully explore the impact of uncertainty, quality and quantity of data, physics-based machine learning (PBML), and digital twin (DT). All these aspects need to be taken into consideration to perform an effective PHM of wind energy infrastructure. To address these aspects, four research questions were formulated. What is the role of uncertainty in machine learning (ML) in diagnostics and prognostics? What is the role of data augmentation and quality of data for ML? What is the role of PBML? What is the role of the DT in diagnostics and prognostics? The methodology used was Preferred Reporting Items for Systematic Review and Meta-Analysis. A total of 143 records, from the last five years, were analyzed. Each of the four questions was answered by discussion of literature, definitions, critical aspects, benefits and challenges, the role of aspect in PHM of wind energy infrastructure systems, and conclusion.

Uncertainty Quantification for Additive Manufacturing Process Improvement: Recent Advances

Sankaran Mahadevan, Paromita Nath, Zhen Hu

ASME J. Risk Uncertainty Part B. Mar 2022, 8(1): 010801.

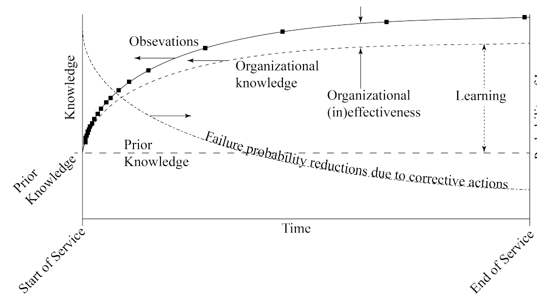
Review article

Abstract

This paper reviews the state of the art in applying uncertainty quantification (UQ) methods to additive manufacturing (AM). Physics-based as well as data-driven models are increasingly being developed and refined in order to support process optimization and control objectives in AM, in particular to maximize the quality and minimize the variability of the AM product. However, before using these models for decision-making, a fundamental question that needs to be answered is to what degree the models can be trusted, and consider the various uncertainty sources that affect their prediction. UQ in AM is not trivial because of the complex multiphysics, multiscale phenomena in the AM process. This article reviews the literature on UQ methodologies focusing on model uncertainty, discusses the corresponding

activities of calibration, verification, and validation, and examines their applications reported in the AM literature. The extension of current UQ methodologies to additive manufacturing needs to address multiphysics, multiscale interactions, increasing presence of data-driven models, high cost of manufacturing, and complexity of measurements. The activities that need to be undertaken in order to implement verification, calibration, and validation for AM are discussed. Literature on using the results of UQ activities toward AM process optimization and control (thus supporting maximization of quality and minimization of variability) is also reviewed. Future research needs both in terms of UQ and decision-making in AM are outlined.

The Essential Role of Clairvoyance in Loss Prevention



The engineering process of risk management in a deployed design.

When engineers are faced with designing protections in a hazardous technological system, they think through scenarios that may lead to protection breakdowns. Such scenarios are posed on understanding of breakdowns that have become known to them through testing, analysis, root cause determinations of in-service failures, and other observations that may be known to the design team. Scenarios are those including breakdowns in protection that result in a loss of a "critical function" or so-called "functional failures". Protective functions are different than the equipment that supports them, as such. For example, a diesel engine providing backup power may not stop running when the operator demands shutdown. The function associated with the diesel shutdown would not necessarily cause a loss of protection. It would be considered a functional failure but not a protective, or critical functional failure. Critical functional failures result in a bridge collapse, collision in rail transportation, chemical process plant explosion and fire, uncontrolled release of toxins to the environment, and so forth.

If all potential protection breakdowns are known to the design team prior to commissioning, engineers can design reliable protections–protections that can be relied upon to provide required critical functional support with great confidence. A non-consequential example is automobile warranties whereby the customer bears no loss for repair if a failure occurs under the warranty period. In this case, the automobile manufacturer can, for example, require lifetime testing under the designed use conditions for functional failure(s) of supplied commodities. Knowing the failure probability for each functional failure in, for example, the drive train, allows the manufacturer to know the probability and associated costs for each functional failure over a finite time horizon. While this strategy is not fool-proof, when armed with such information, the manufacturer can tailor warranty programs that would prevent a financial loss in a fleet of automobiles with good confidence. When warranty programs fail, it is normally the result of a functional failure embedded in the design that, until the design has been deployed, is unknown to the design team. It might be expected that exposure to such failures is greater when when a design includes significant innovations.[1] It could be said that in such warranty program failure cases, the only way to anticipate them would be for the engineers to have a gift of clairvoyance. Engineers certainly understand they lack a gift of clairvoyance. This guides them, based on observations of historical failures, in the design of protections against hazards.

It could be said there are two classes of protections that come with hazardous system designs, those that are closely related to liability and those that overlay liability exposure. The ones related to liability generally amount to something like a "bet" that owners and investors are willing take based on their assessment of risk. The ones that overlay liability are generally related to the moral hazard, the risk on the bet where citizens may be exposed to the consequence of the bet gone bad, and they are generally the subject of regulation. The costs of regulatory protections against "bets gone bad" are in addition to other protections. All costs for protections are ultimately are passed on to citizens who gain access to the goods and services produced by the owners and investors.

Because engineers know they will need to respond to unexpected failures when products are deployed and operated, they have developed sophisticated processes and technologies such as root cause analysis and destructive and nondestructive examination to learn what happened. Knowing what went wrong, they then design cost-effective modifications to prevent future failures from the same cause. This is the process whereby organizational knowledge, observations of failures in service, and design modifications is used to manage risk exposure in hazardous designs as summarized in the figure above.

Let's talk!
Ernie Kee, SERAD Editor

Ernie's Newsletter on SubStack

[1]For example see the study in Mackelprang, A.W., Habermann, M. and Swink, M., 2015. How firm innovativeness and unexpected product reliability failures affect profitability. Journal of Operations Management, 38, pp.71-86.

SERAD Committee

Table 1. 2021–2022 SERAD Committee Membership

Executive Committee		Appointments	
Position	Person	Position	Person
Chair	Xiaobin Le	**Nominating Chair**	Mohammad Pourgol-Mohammad
1st Vice-Chair	Arun Veeramany	**Award Chairs**	Jeremy Gernand John Weichel
2nd Vice-Chair-Treasurer	Stephen.Ekwaro-Osire@ttu.edu	**Newsletter Editor**	Ernie Kee
3rd Vice Chair-Membership	madiacon@ncsu.edu	**Webinars / Outreach Chair**	Open
4th Vice-Chair-Secretary	Andrey Morozov	**Student Program Coordinator**	Deivi Garcia
Past Chair	Mohammad Pourgol-Mohammad	**Technical Content Coordinator**	Giulio Malinverno
IMECE 2022 Track Chair	Bill Munsell	**IMECE 2022 Track Co-Chairs**	Andrey Morozov Mihai Diaconeasa Ernie Kee John Wiechel Alice Sun