SAFETY ENGINEERING & RISK ANALYSIS DIVISION

Division Newsletter
Volume 11, Fourth Quarter

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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.

Our division successfully sponsored Track 14–Safety Engineering, Risk and Reliability Analysis in International Mechanical Engineering Congress & Exposition (IMECE2021) held as a virtual conference during November 1–5, 2021. We had 55 presentations, 49 papers, and 6 technical presentations. We will continuously sponsor a track in IMECE2022. The good news is that the IMECE2022 will be an in-person conference. Please start preparing papers of your research work or case study related to safety engineering, risk, and reliability analysis, and join the IMECE2022 in-person conference. Please stay tuned to get more detailed information about IMECE2022.

The division had a hugely successful online ASME SREAD award ceremony on November 11, 2021, during ASME IMECE2021 virtual conference. The awards were winners and honorable mention awards of the student innovation challenge competition and the winners of two best papers for the 2020 papers of ASME-ASCE journal of risk and uncertainty in engineering systems both parts A and B in civil and mechanical systems. We appreciate FM Global sponsoring the student innovation challenge competition. This year, we had a hugely successful student challenge competition with ten papers inducing undergraduates and graduates. If your organization could sponsor our student innovation challenge competition, please contact us and we appreciate your support. During the award ceremony, students' winners briefly explained their research projects. Dr. Alba Sofi and Dr. Yue Hu, winners of the two best papers did wonderful technical presentations during the award ceremony. Next year, we will hold our award ceremony in a restaurant with wonderful presentations and delicious foods.

Our division is diligently working on the division strategic plan and creating the division mission and vision to serve you better. The primary goal of the SERAD division is to create suitable platforms to serve our members, you. We need your help and inputs. If you have any suggestions or need any help, please feel free to contact us.

Wishing you a happy, healthy New Year!

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

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.

Starting with 2022, the editorship of the journal will be transferred from the Founding Editor-in-Chief, Professor Bilal M. Ayyub, to 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 3 (September 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, In progress)
	2021 Table of Contents		
Part A	Volume 7-Issue 4 (December 2021)	Part B	Volume 7-Issue 4 (December 2021)
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

"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 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

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

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

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

Recognitions & Awards

Recognitions for Papers

Part A	
Editor's Choice Paper	"Investigating the Effect of Geological Heterogeneity of Strata on the Bearing Capacity of Shallow Foundations Using Markov Random Field" by Dongming Zhang, Hongfeng Dai, Hui Wang, Hongwei Huang, and Dejun Liu
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 was 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 was held online during the period November 1–5, https://event.asme.org/IMECE. The recipients of the 2020 Best Paper Award will receive the award's certificate/plaque by mail.

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).

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

Automated Transformation of uml/sysml Behavioral Diagrams for Stochastic Error Propagation Analysis of Autonomous Systems

Andrey Morozov, Thomas Mutzke, and Kai Ding
ASME J. Risk Uncertainty Part B. September 2022; 8(3): 031102.

Abstract

Modern technical systems consist of heterogeneous components, including mechanical parts, hardware, and the extensive software part that allows the autonomous system operation. The heterogeneity and autonomy require appropriate models that can describe the mutual interaction of the components. Uml and sysml are widely accepted candidates for system modeling and model-based analysis in early design phases, including the analysis of reliability properties. uml and sysml models are semiformal. Thus, transformation methods to formal models are required. Recently, we introduced a stochastic Dual-graph Error Propagation Model (DEPM). This model captures the control and data flow structures of a system and allows the computation of advanced risk metrics using probabilistic model checking techniques. This article presents a new automated transformation method of an annotated State Machine Diagram (SMD), extended with Activity Diagrams (ADs), to a hierarchical DEPM. This method will help reliability engineers to keep error propagation models up to date and ensure their consistency with the available system models. The capabilities and limitations of the transformation algorithm are described in detail and demonstrated on a complete model-based error propagation analysis of an autonomous Medical Patient Table (MPT).

Bayesian Calibration of Multiple Coupled Simulation Models for Metal Additive Manufacturing: A Bayesian Network Approach

Jiahui Ye, Mohamad Mahmoudi, Kubra Karayagiz, Luke Johnson, Raiyan Seede, Ibrahim Karaman, Raymundo Arroyave, and Alaa Elwany
ASME J. Risk Uncertainty Part B. March 2022; 8(1): 011111.

Abstract

Modeling and simulation for Additive Manufacturing (AM) are critical enablers for understanding process physics, conducting process planning and optimization, and streamlining qualification and certification. It is often the case that a suite of hierarchically linked (or coupled) simulation models is needed to achieve the above tasks, as the entirety of the complex physical phenomena relevant to the understanding of process-structure-property-performance relationships in the context of AM precludes the use of a single simulation framework. In this study using a Bayesian

network approach, we address the important problem of conducting Uncertainty Quantification (UQ) analysis for multiple hierarchical models to establish process-microstructure relationships in Laser Powder Bed Fusion (LPBF) AM. More significantly, we present the framework to calibrate and analyze simulation models that have experimentally unmeasurable variables, which are quantities of interest predicted by an upstream model and deemed necessary for the downstream model in the chain. We validate the framework using a case study on predicting the microstructure of a binary nickel-niobium alloy processed using LPBF as a function of processing parameters. Our framework is shown to be able to predict segregation of niobium with up to 94.3% prediction accuracy on test data.

Resilience Assessment and Importance Measure for Interdependent Critical Infrastructures

Xing Liu, Yi-Ping Fang, Elisa Ferrario, and Enrico Zio

ASME J. Risk Uncertainty Part B. September 2021; 7(3): 031006.

Abstract

Based upon a novel control-based dynamic modeling framework, this paper proposes two new indicators, i.e., resilience by mitigation and resilience by recovery, for the resilience analysis of Interdependent Critical Infrastructures (ICIs) under disruptions. The former is built from the protection activities before and during the mitigation phase of a disruptive event, and the latter is the result of the restoration efforts, which take place at the recovery phase. The total resilience of ICIs combines both of these two aspects by taking into account the preferences of the decision makers. We demonstrate the applicability of the proposed modeling framework and metrics in a case study involving ICIs made of a power grid and a gas distribution system. Owing to the new resilience indicators, the priorities of subsystems and links within ICIs at different phases can be ranked; therefore, different resilience strategies at different phases of disruptive events are compared. The results show that proposed metrics can be used by stakeholders of ICIs on improving the effectiveness of system protection measurements.

Stochastic Response Analysis and Reliability-Based Design Optimization of Nonlinear Electromechanical Energy Harvesters With Fractional Derivative Elements

Ioannis Petromichelakis, Apostolos F. Psaros, Ioannis A. Kougioumtzoglou

ASME J. Risk Uncertainty Part B. March 2021; 7(1): 010901.

Abstract

A methodology based on the Wiener Path Integral (WPI) technique is developed for stochastic response determination and reliability-based design optimization of a class of nonlinear electromechanical energy harvesters endowed with fractional derivative elements. In this regard, first, the WPI technique is appropriately adapted and enhanced to account both for the singular diffusion matrix and for the fractional derivative modeling of the capacitance in the coupled electromechanical governing equations. Next, a reliability-based design optimization problem is formulated and solved, in conjunction with the WPI technique, for determining the optimal parameters of the harvester. It is noted that the herein proposed definition of the failure probability constraint is particularly suitable for harvester configurations subject to space limitations. Several numerical examples are included, while comparisons with pertinent Monte Carlo simulation (MCS) data demonstrate the satisfactory performance of the methodology.

Prognostication Complications

"Risk", when conceptualized as a quantified arrival probability a pre-diagnosed state in a reasonably complex technological system will be realized (in the future), involves complications that are difficult to ignore. Topping the list are the following three:

1. Time must exist,
2. Event probabilities must be proposed, and
3. Proposed probabilities must be validated.

The list is not comprehensive, but nearly so. For example, Solberg and Njå identify five elements that include uncertainty and consequences but leave validation out:

> "…, we find five common elements concerning the concept of risk. Those are: time (the future), events, consequences, uncertainty and something of human value related to the consequences."

Uncertainty is essentially probability, but consequences and human value are candidates for addition to the list. However, it seems risk could be evaluated, as such, and human value as Solberg and Njå point out, could subsequently be assigned according to individual preference and circumstances at the time of the particular event.

Time is inextricably connected because risk determination requires assessment of the past, the present, and the future states of affairs albeit, under incomplete knowledge. Another view is that the existence of future states must be based on what is known at the present. For example, a realistic process may ask for a motor to be actuated by a relay when the pressure, in a monitored system decreases below a set point. Ideally, the pressure transducer and the relay would have unbiased random errors in pressure measurement and relay actuation. It is unlikely the pressure measurement error and the relay actuation error would be correlated. Therefore, in his example, quantifying the probability, for actuation at the proper pressure would be straightforward. Now suppose these devices are in a realistic protection setting that includes redundant channels and regular maintenance on a staggered basis. The redundant configuration may be designed to avoid "false" actuations by, for example, including an auctioneering scheme, say two out of four pressure measurements at the relay set point, to actuate the relay. Maintenance typically checks the output over the range of operation to ensure, or alternatively, adjust outputs within required tolerances. Under this circumstance, the random errors would become time-dependent. It is furthermore unlikely that over time the pressure transducer and the relay settings would remain unbiased. In robust designs such as the one with redundancy described, actuation signal failures would be rare. Therefore, the maintained system with time-dependent future probability of failure probability would be difficult not only to quantify, but to validate, in any proposed quantification scheme.

What can be done to overcome the complications of time, knowledge, and validation? It seems ideas such as UQ may not be sufficient since they also fail to overcome uncertainty (state of knowledge) contained in the physical models used in UQ simulations. A typical example is outlined by Mandelli et al. where a reactor safety simulation is integrated into a sophisticated Probabilistic Risk Assessment (PRA) logic structure that would give probability of failure absent data support (for the quantified probabilities). It could be said that engineers understand risk management as a control problem with feedback. That is, they from observations of the current state of affairs, they make adjustments to overcome the uncertainty inherent in past decisions. By performing root cause analysis on unexpected states, they can better inform future performance. Another example is the tightly coupled feedback process used to guide a controllable missile to accurately hit a target. In this example, the target is made to produce a signal to which the missile continuously adjusts its path. Engineers inherently recognize that the more real time control that can be exercised, the better they can manage risk going forward. Condition-based maintenance and operating equipment instrumentation telemetry reflect the nature of practical engineering risk management. Such tools continuously update the engineer on the current state of affairs so she can react appropriately to unexpected observations.

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.

References

Mandelli, D., A. Alfonsi, C. Wang, Z. Ma, C. Parisi, T. Aldemir, C. Smith, and R. Youngblood (2021). Mutual integration of classical and dynamic pra. *Nuclear Technology 207*(3), 363–375.

Solberg, Ø. and O. Njå (2012, October). Reflections on the ontological status of risk. *JOURNAL OF RISK RESEARCH 15*(9), 1201–1215.

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