SAFETY ENGINEERING & RISK ANALYSIS DIVISION

Division Newsletter Volume 15, Fourth Quarter

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Chair's Message

Dear SERAD Members,

This is the newsletter for the second quarter of the ASME Fiscal Year 2023 and we all at SERAD would like to wish you a happy and prosperous 2023! This past quarter had been quite hectic for the SERAD team across multiple activities. We have seen our LinkedIn listed group garner more members and hope to hear from more of you in the coming quarters.

The most eventful aspect was of course, organizing the Safety Engineering, Risk and Reliability Analysis track at the IMECE 2022 conference under the leadership of SERAD Track Chair Bill Munsell. The conference was held at the Greater Columbus Convention Center, Columbus in Ohio between October 30 and November 2. The SERAD IMECE session was kicked off with plenary talk by Carol Smidts, Professor of Mechanical and Aerospace Engineering at the Scott Laboratory of the Ohio State University. The SERAD student presentations were held virtually, and the winning students were awarded their plaques and certificates in person in proximity to the IMECE venue. Prof. Stephen Ekwaro-Osire organized the successful dinner award night as well as the in person SERAD executive committee meeting. The planning behind all these events was spectacularly orchestrated by Mihai Diaconeasa, Andrey Morozov, and Alba Sofi under the senior management leadership of April Tone. Papers from the proceedings worthy of publishing will be vetted by Alba Sofi and her team for consideration in Journal of Risk and Uncertainty in Engineering – Part B Mechanical Engineering.

Other noteworthy activities have been in the areas of ASME robotics road-mapping exercise and for the upcoming Joint Railroad Conference (JRC). SERAD will be submitting its impactful robotics roadmap from a risk perspective in this quarter. JRC will be partly sponsored by SERAD and a dedicated track will be chaired by Prof. Mohammad Porgol-Mohamad. Ernie Kee has been working closely with April Tone to have a TEC talk submitted on nuclear safety. Our opportunities are piling up and we would like to match them with your volunteer expertise! Please come join us on LinkedIn and choose SERAD as your primary membership in your ASME account settings.

Sincerely,

Arun Veeramany, Chair for FY23, ASME SERAD

Links to SERAD Activities

Links to SERAD Activities

LinkedIn: ASME Safety Engineering and Risk Analysis Division

The ASME SERAD Home page

ASME Safety Engineering & Risk Analysis Division Home Page

The Joint Rail Conference 2023 Track 5 Sponsored by SERAD

Joint Rail Conference 2023 Track 5

ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems. Part B: Mechanical Engineering

Mechanical Engineering

Recent SERAD Student Contest Winners

2022 IMECE 2022 SERAD News and Awards Presentation

The ASME IMECE 2022 conference was a great success. The timing of the conference at the of the year allowed for in-person as opposed to virtual attendance.

The SERAD Awards ceremony was well attended and everyone enjoyed an excellent evening together. Prof. Stephen Ekwaro-Osire presented awards on Wednesday evening and to keynote speaker Prof. Carol Smidts The SERAD awards dinner was well attended. Hors d'Ouveres were served at the social before dinner and awards were presented by Prof. Stephen Ekwaro-Osire to students and track organizers.

Prof Smidts accepts IMECE 2022 Track 14 Keynote award from Prof. Stephen Ekwaro-Osire

Summary of risk integration and comparison safety study between generation II light water reactors and generation IV non-light water reactors

First Place Winner
by **Elijah Rushing**,
North Carolina State University, Raleigh, NC

INTRODUCTION

Nuclear energy provides an opportunity for harnessing energy while causing minimal harm to the environment. However, this opportunity in energy harnessing needs to be done in a manner that minimizes harmful impact, with one of those impacts being nuclear radiation. To quantify the impact of nuclear radiation, Probabilistic Risk Assessment (PRA) is used. PRA is a method to estimate risk by computing real numbers to determine what can go wrong, how likely it is to happen, and its degree of damage. In 1975, WASH-1400 (a report that covered a Boiling Water Reactor (BWR) from Peach Bottom, Pennsylvania and a Pressurized Water Reactor (PWR) in Zion, Illinois) was published that was deemed as the first time the PRA was successfully conducted.

Nuclear reactors can be classified by the nuclear reactor's generation (gen). The High Temperature Gas Cooled Pebble Bed Reactor (HTGC-PBR) is a gen IV reactor. The HTGC-PBR is discussed in the HTGC-PBR Licensing Modernization Project (LMP) demonstration. One of the attributes of the gen IV reactors is the increased safety, as those reactors bring in the use of passive safety systems for all emergency conditions. The passive safety systems do not require human intervention to work.

SCOPE

The aim of this research is to examine and to compare the safety levels of the following reactors using probabilistic risk assessment: Zion PWR (WASH-1400), Peach Bottom BWR (WASH-1400), and HTGC-PBR (LMP demonstration). To do this, the frequency and dose of event sequences of the three reactors were graphed against the Frequency-Consequence Target graph described by the United States Nuclear Regulatory Commission (USNRC). The frequency is analyzed on a per plant-year basis. The dose was determined at the 30-Day Total Effective Dose Equivalent (TEDE) (rem) at Exclusion Area Boundary.

APPROACH

The list of event sequences for the BWR and PWR were given in WASH-1400. The list of event sequences for the HTGC-PBR was given in the NEI 18-04 pilot study. The frequency was then calculated using an event tree analysis and systems analysis (consisting of a fault analysis). A consequence analysis was then conducted to determine the dose using eq. (1). Finally, the frequency and dose associated with a given event sequence was plotted against the Frequency-Consequence Target graph described by the USNRC.

$$\textsc{Dose} = 0.507\, \overline{E}_\gamma \frac{\chi}{Q} q \tag{1}$$

$\overline{E}_\gamma$ is the average gamma energy (which was assumed to be 1 MeV), $\chi \,/\, Q$ is the atmospheric dispersion factor, and q is the total radioactivity release rate.

MAIN CONCLUSIONS

Figure 2 displays the results as a plot in which all three reactors are plotted together using the frequency and dose data. Also, if being viewed with color, the red data points correspond to the Frequency-Consequence Target graph described by the USNRC and a red line at 1E^{-10} per plant-year.

One in ten billion years is around one event in the current assumed age of the universe. Therefore, anything that falls below the 1E^{-10} per plant-year line is not what would be expected for this universe. The frequencies that fell below this line came from WASH-1400. WASH-1400 used only the bottom-line probabilities and did not characterize, quantify, or include the uncertainties. As the Lewis committee concluded, a thorough uncertainty analysis, or if an uncertainty analysis was not possible, then a sensitivity study, should have been done to have a better understanding of the results. Although, WASH-1400 did not include uncertainties with the bottom-line probabilities, the overall conclusion of this work is still valid, and the data can still be used; however, the data may need to be used with caution and awareness of the lack of uncertainty.

This study examined and compared the frequency and dose data for two light water reactors (BWR and PWR) and one non-light water reactor (HTGC-PBR). This study showed that the non-light water reactor releases lower doses than the light water reactors. However, the non-light water reactor did have higher frequencies. This can be explained through the lack of operational experience that individuals have with the HTGC-PBR. All three reactors did meet the regulatory safety limits.

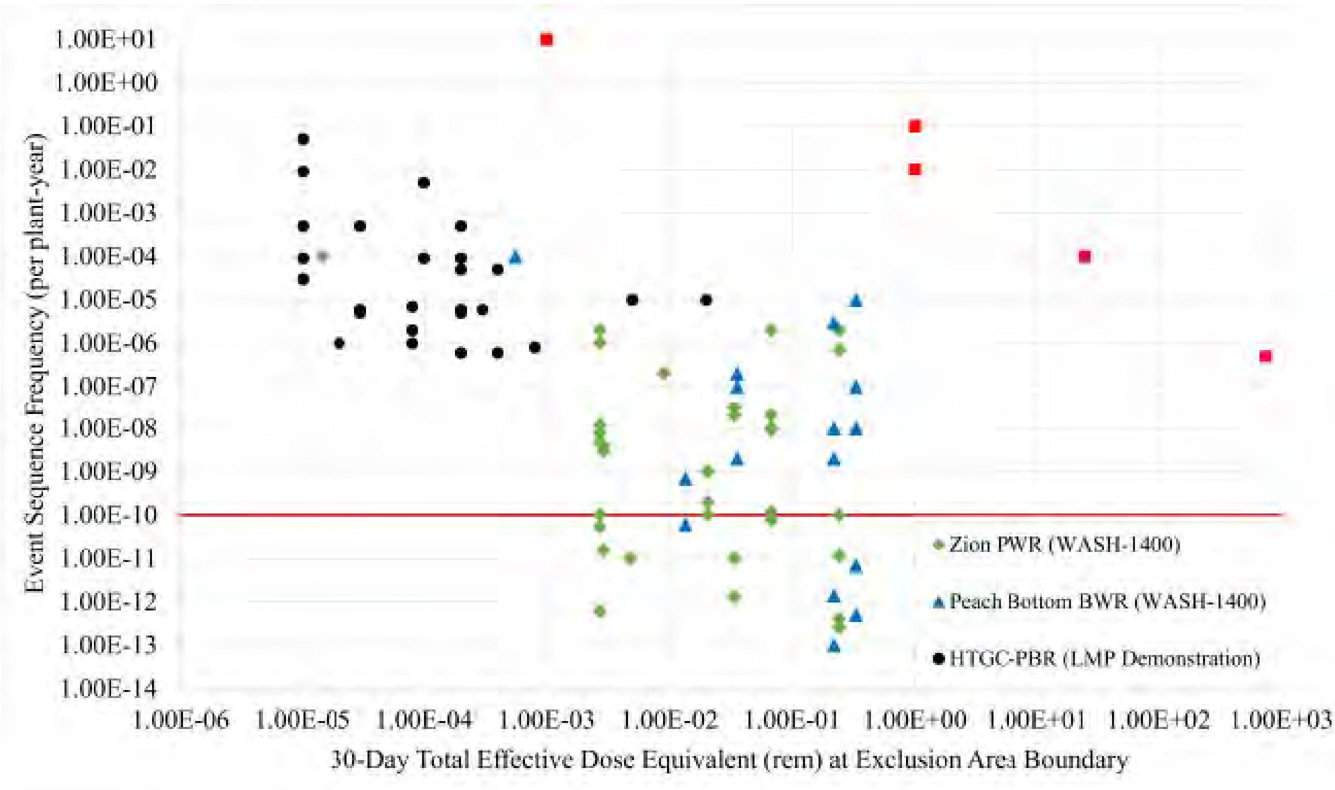


Figure 2. Combination of Reactors Frequency vs. Dose against the F-C Target (red dots) and screening frequency (red line).

Incipient Failure Detection Based on Multiscale Diversity Entropy

First Place Graduate Student Winners
by **Nazir Laureano Gandur, Camilo Lopez-Salazar**,
Texas Tech University

In the field of Prognostics and Health Management (PHM) since many data-driven approaches to calculate Remaining Useful Life (RUL) of industrial machinery components depend on the correct prediction of the Incipient Failure (IF) point. Therefore, it is necessary to improve current methodologies so the IF point can be located more precisely and based on the physics of the phenomena.

In general, an IF is an imperfection in the state or condition of a mechanical component so that a critical failure can be expected as a result, if corrective actions are not taken. For any monitoring signal coming from a mechanical system, the IF point is the moment of time that indicates the beginning of the degradation stage prior to failure. In this way, RUL prediction can be performed knowing when the IF point occurs along with the degradation rate. However, poor estimation of the IF point leads to propagation of error for this estimation.

Diversity entropy (DE) is a measurement of dynamical complexity from an arbitrary time series. DE uses statistical probability of pattern similarity to describe the state distribution. The calculated DE is a physical quantity that compares the dynamical complexity between different systems, or as an indicator of the current health condition of industrial machinery. DE is a function of the time series data points, an embedding factor m, and number of intervals

ϵ. However, the entropy from a single scale could contain poor fault information, then a multiscale approach is used to capture information thought different scales. Multiscale DE (MDE) ends up as a function of the time series, a scale factor τ, along with DE parameters m, ϵ. The process of calculating MDE is explained step by step in this work.

Statistical approaches and heuristics are widely used to determine IF. In this work a very known six-sigma methodology is used as base calculation in which apply MDE for comparison. In principle, the IF is the point where the signal start to flow out of the range from $\mu - 6\sigma$ to $\mu + 6\sigma$. Where μ and σ are the baseline and standard deviation of the monitoring signal. Even though this method is robust for IF detection, it does not consider information form the physics of the system.

To assess adaptability of the proposed methodology, MDE is tested on two different datasets. First, a dataset of bearing vibration signals was used at three operating conditions. For each operating condition, five tests were performed until the fault was reached. The RMS of the horizontal vibration signal for each bearing was plotted; the sampling frequency is set to 25.6 kHz. Second, a dataset of five Li-ion batteries was used. Repeated charge, discharge and impedance cycles were run in an accelerated aging process of the batteries. The experiments were stopped when the batteries reached end-of-life (EOL) criteria, which was a 30% fade in rated capacity (from 2Ahr to 1.4Ahr).

Finally, the MDE was used associated to baseline methodology to bring physics into the IF point detection model. A change in the dynamic of the systems was reflected by a change in the system MDE measurement. For bearing dataset the parameters used were $m = 3$, $\epsilon = 10$ and $\tau = 20$, and for battery dataset $m = 3$, $\epsilon = 100,000$ and $\tau = 1$. The major contributions in this paper were to improve IF prediction, the results for this novel approach to predict IF clearly demonstrate the effectiveness of the proposed method on both kind of dataset.

Implementation of an RNN and CNN-LSTM for turbofan remaining useful life estimations using the C-MAPSS datasets

Second Place Graduate Student Winner

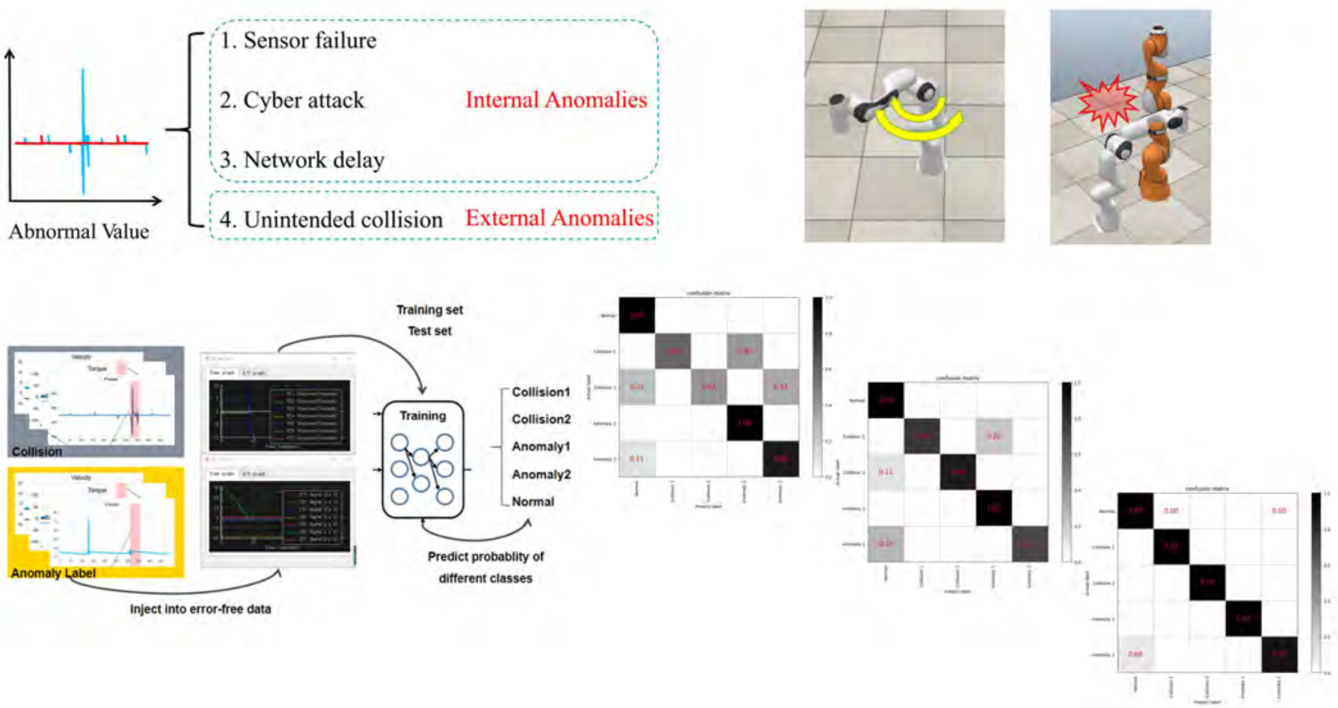
by **Colin Andrew Schell**,
University of Maryland

Estimating the remaining useful life of complex engineering systems is a challenging task due to the difficulty of modeling the physical system and its underlying components, the quantity of data that must be collected and processed, and the diversity of operating conditions and failure modes that the system may deal with. Condition-based maintenance strategies use temporal data from the system in order to monitor the health of the system in real time and estimate its remaining useful life. Neural networks can detect complex patterns in data without requiring an understanding of the data generating mechanisms making them well suited for condition-based maintenance models. In this paper, a set of neural network models including simple RNNs, LSTMs, GRUs, and CNNs were used to estimate the remaining useful life of turbofans using the FD001 (one operating condition and one failure mode) and FD004 (six operating conditions and two failure modes) datasets from C-MAPSS. A design of experiments approach was used to identify dominant hyperparameters and select the top performing models. For FD001, the top performing LSTM model architecture achieved a test RMSE of 13.48 while the top performing CNN-LSTM network achieved a test RMSE of 14.66. The additional operating conditions and failure modes included in FD004 resulted in poor model performance for each model architecture due to the greater number of patterns for the model to detect and predict. Overall, the design of experiments approach to hyperparameter searching was deemed ineffective due to the effects of RMSE variance. Increasing the number of epochs to train each model on or running more models and averaging the results would decrease RMSE variance, but led to excessive computation times. It is suspected that the CNN model architecture has the potential to achieve better results on the FD001 and FD004 datasets given a more intelligent hyperparameter search.

Detection and classification of robotic manipulator anomalies using MLSTM-FCN models

Third Place Graduate Student Winners

by **Yuliang Ma, Philipp Grimmeisen**,
University of Stuttgart, Germany



Detection and Classification of Robotic Manipulator Anomalies Using MLSTM-FCN Models

Errors and failures occur inevitably in modern Cyber-Physical Systems (CPS) due to their structural variability and internal heterogeneity. This can cause economic losses or even hazardous accidents. Currently, deep learning-based anomaly detection methods, e.g., Transformer or LSTM-based detectors, have shown tremendous results in terms of anomaly detection and prevention. However, focusing solely on improving detection performance without classification and interpretation of the detected anomalies is not enough for many industrial scenarios. Instead of only reporting an anomaly, the detection results should be understandable and transparent for the users. The interpretability can provide some guidance and help to identify suitable countermeasures for different types of anomalies. In this paper, we introduce a Multivariate Long Short Term Memory Fully Convolutional Network (MLSTM-FCN) for anomaly classification based on multivariate time-series data generated from industrial robotic manipulators. Specifically, we investigate several scenarios: no collision, collision with another manipulator, and manually injected sensor faults. We collect time-series data from the simulations of robotics arms using CoppeliaSim software. We feed these data into the MLSTM-FCN model and train it to be a multivariate time-series classifier. The paper presents the simulative case study results that show that the MLSTM-FCN model can efficiently classify different types of anomalies. In our experiments, we compared the effect of different input features on the classification precision. The results show that observing torque sensor data only is not adequate for distinguishing internal anomalies and external anomalies. However, adding other constraints based on prior physics knowledge of CPS, such as velocity and power of a manipulator, can significantly improve classification precision. Based on this result, we conclude that adding a physics-based constraint to a neural network is a useful and natural choice for the analysis of detected anomalies, which can provide more understandable and intuitive detection results for users.

Replicating the methods of Alsaedi et al. 2018, 'Extended Cox proportional hazard model to analyze and predict conversion from mild cognitive impairment to Alzheimer's disease'

Honorable Mention Graduate Student Winner
by **Camille Levine**,
University of Maryland

Cox Proportional Hazard (PH) models were run on data obtained from the National Alzheimer's Coordination Center to determine demographic and medical predictors of Alzheimer's Disease in patients. The Clinical Dementia Rating (CDR) metric was used to determine if the patient had impaired cognitive function, and the age at conversion to impairment was used as the time to failure. The CDR rates patients on several domains, including memory, problem-solving and judgment, and comport. The global CDR score is then computed using an algorithm in which memory is the primary variable. Another commonly used metric for cognitive impairment is the Mini-Mental State Examination (MMSE), the predictive ability of which is tested in Alsaedi et al's work.

In this analysis, the variables of Handedness, Marital Status, Race, Sex, MMSE Score, Home and Hobbies CDR, Judgment CDR, and Years of Education were considered as potential predictor variables for a demographic-cognitive model. A second model considering medical history was developed using Hypertension, Hypercholesterolemia, Depression, Years Smoked, and Family History as predictors. The majority of patients in this data were white, non-Hispanic, and unmarried, with a mean age of 74.1 ($\pm$9.68) and a mean years of education of 15.0 ($\pm$3.37); there were $n = 28,332$ individuals. Data was dropped for patients younger than 50.

The Cox PH model assumes a baseline hazard $\lambda_0(t)$ that is multiplied by a vector of regression parameters, β, and a vector of conditions, z. Under standard conditions, $z = 0$, so the overall hazard is equal to the baseline hazard. The regression coefficients β represent the proportional increase in hazard when the condition increases by 1. The equation for this model is shown below.

$$\lambda(t; z) = e^{z\beta}\lambda_0(t).$$

The demographic-cognitive model found that having a low Judgement CDR score, and being unmarried, Hispanic, or white significantly increased the hazard to individuals. An increase in Judgement score by 1 increased the hazard by a factor of 1.58, and being unmarried doubled the hazard. The medical history model found that having active depression in the past two years resulted in the highest hazard increase, by a factor of 1.69. All of the regression coefficients obtained were significant to a $p < 0.05$ level. A sensitivity analysis was run for each of the factors considered in the two models in order to visually compare the effect of each predictor variable.

Ultimately, the results of this work did not replicate those found in Alsaedi et al's analysis. Future work done on this topic may involve better tuning of the Cox PH model as the regression analysis is relatively sensitive to the dataset, preprocessing, and variables included. This dataset is rich with a variety of factors, so future analyses could be done on other combinations of factors, or a machine-learning approach could be implemented to determine which of these combinations to further pursue. The application of these results to medical practice is another opportunity for further research in pre-screenings and longitudinal patient outcomes.

Reference

Alsaedi, A., I. Abdel-Qader, N. Mohammad, and A. C. Fong (2018). Extended cox proportional hazard model to analyze and predict conversion from mild cognitive impairment to alzheimer's disease. In *2018 IEEE 8th annual computing and communication workshop and conference (CCWC)*, pp. 131–136. IEEE.

Call for Papers

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. 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 for 2021 of 3.084 based on the latest Journal Citation Reports by Clarivate Analytics.

Contents

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

"A Recent Review of Risk-Based Inspection Development to Support Service Excellence in the Oil and Gas Industry: An Artificial Intelligence Perspective", by Taufik Aditiyawarman, Agus Paul Setiawan Kaban, Johny Wahyuadi Soedarsono

"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 Structural Time-Dependent Reliability Assessment: Advanced Approaches for Engineered Structures" Cao Wang, Hao Zhang, Michael Beer

"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 Decommissioning and Life Extension of Complex Industrial Assets" Raphael Moura, Michael Beer, Gilberto Francisco Martha de Souza, and Edoardo Patelli

"Special Section on Risk, Resilience, and Reliability for Autonomous Vehicle Technologies: Trend, Techniques, and Challenges" Mohammad Pourgol-Mohammad, Arun Veeramany, and Bilal Ayyub

"Special Section on Probabilistic Approaches for Robust Structural Health Monitoring of Wind Energy Infrastructure" Imad Abdallah and Eleni Chatzi

"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	"Risk-Informed Bridge Optimal Maintenance Strategy Considering Target Service Life and User Cost at Project and Network Levels" by Xu Han and Dan M. Frangopol
Most Read Paper	"Structural System Reliability: Overview of Theories and Applications to Optimization" by Junho Song, Won-Hee Kang; Young-Joo Lee, and Junho Chun
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	"Two-Step Algorithm to Detect Cyber-Attack Over the Can-Bus: A Preliminary Case Study in Connected Vehicles" by Marco Lombardi, Francesco Pascale, Domenico Santaniello
Most Cited Paper	"Digital Twins: State-of-the-Art and Future Directions for Modeling and Simulation in Engineering Dynamics Applications"" by D. J. Wagg, K. Worden, R. J. Barthorpe, P. Gardner
Featured Article	"Resilience Decision-Making for Complex Systems", by Julian Salomon, Matteo Broggi, Sebastian Kruse, Stefan Weber, Michael Beer

Outstanding Reviewers

Part A 2021 Outstanding Reviewers	Part B 2021 Reviewers of the Year
André T. Beck	Chen Jiang, *Huazhong University of Science and Technology, China*
Nicholas Chileshe	Imad Abdallah, *Eidgenössische Technische Hochschule Zürich, Switzerland*
You Dong	
Ketson Roberto Maximiano dos Santos	
Ao Du	
Cheng-Wei Fei	
Wenping Gong	
Cao Wang	
Jie Zhang	
Wengang Zhang	

Best Paper Award[1]

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.

2021 Part A Recipients
Authors: Ali Khodam, Pooria Mesbahi, Mohsenali Shayanfar, Bilal M. Ayyub
Title: "Global Decoupling for Structural Reliability-Based Optimal Design Using Improved Differential Evolution and Chaos Control"

[1]On October 21st, the winners of the 2021 Best Paper Award for the ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems (Part A and Part B) and of SERAD Student Contest 2022 presented the main findings of their papers at a virtual event organized by the ASME Safety Engineering and Risk Analysis Division (SERAD).

2021 Part B Recipient
Author: Panagiotis Alevras
Title: “On the Effect of the Electrical Load on Vibration Energy Harvesting Under Stochastic Resonance”

Early Career Editorial Board

Starting in 2020, the ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems in its two parts has implemented the Early Career Editorial Board (ECEB) program to bring onboard young members to its editorial board under the mentorship of the journal leadership.

After a selection procedure, eight new ECEB members have been appointed for the next two years.

Part A: active Calls for Special Collections

Special Collection on ”Advances in Efficient Methods in Random Fields Modeling and Analysis”. Paper submission deadline: March 31, 2023.

Part B: active Calls for Special Issues

Special Issue on “Special Issue on Digital Twins: A New Frontier in Critical Infrastructure Protection and Resilience” (SI053B). Paper submission deadline: January 31, 2023.

Special Issue on “Community Resilience to Disruptive Events: Models and Analyses, Lessons Learned, and Case Studies” (SI055B). Paper submission deadline: February 28, 2023.

Special Issue on “Uncertainty Quantification & Management in Nonlinear Dynamical Systems in Aerospace and Mechanical” (SI058B). Paper submission deadline: March 31, 2023.

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).

The protective system challenge in the energy crisis (continued from last quarter)

The past most previous Wearout referred to the staggering amount of energy consumed worldwide, amounting to about 420 EJ and increasing year by year.[2] Nuclear fission technology appears to be gaining popularity as it appears to hold potential for offsetting fossil fuel consumption. But as pointed out in that previous Wearout, the potential requirement, in terms of numbers of large fission power plants, would be enormous, amounting to almost 9,000 such plants. The US DOE has shown interest in Small Modular (fission) Reactors (SMRs) in part as a safer technology and as a way to alleviate investor concern with fission technology. Wearout sees some reliability-centered and investment-centered challenges with using SMR technology to fully or even partially displace existing fossil fuel technologies. If the SMRs being considered produce about 300 MWe, this will require about 50,000 SMRs instead of about 9,000 large reactors to displace all fossil fuel energy technologies. A straightforward result from reliability engineering is that the number of failures in service will increase approximately linearly with the number of devices subjected to failures. If current performance of large reactors is acceptable, SMR technology would need to be at least five times better to maintain acceptable performance ignoring "fat tails" that may be present in multi-unit sites. From the investment perspective, cost performance is gained by standardizing on a design and manufacturing at scale. Reliability is partly improved this way over time because the opportunity to discover and repair a safety-related but non-consequential protection failure would extend over many reactors. An investment concern may be recent history that indicates when a significant accident (say, INES Level 5 or greater) occurs at one reactor on a multi-unit site, all the reactors on that site are affected (with the possible exception the Unit 4 accident at Chernobyl). Additionally, if the exceptional fission reactor safety record is maintained, the SMR per-megawatt operating cost is unlikely to be significantly different from the existing reactor fleet.

Fusion technologies avoid effectively all the risk factors posed by fission technologies including waste, weapons proliferation, and accident consequences while bringing the same benefit in terms of CO_2-free energy. However, depending on the technology selected, fusion can generate or inventory radioactive material although in minimal amounts compared to fission technologies. A good background on the current fusion technologies being developed is given in the slides presented by Derek Sutherland (Commonwealth Fusion) in the 01/26/2021 NRC Public Meeting slide package.[3] Depending on the technology that can actually be deployed with $Q > 1$, radioactive materials may be produced through one or two processes, or not produced at all.[4]

No fusion technologies currently under consideration have risk of meltdown from runaway reactivity, no long-lived radioactive waste intrinsic to the process, and no usage of special nuclear material. The most viable fusion technology currently under consideration, based on Lawson's criteria, uses deuterium and tritium. There are basically two sources of radioactive risk fusing deuterium and tritium – neutron activation of materials and accidental radioactive tritium release. Next in increasing Lawson criteria challenge is fusing deuterium. Substituting deuterium for tritium eliminates the possibility for accidental tritium release but retains the neutron activation source. Research may show otherwise but the most challenging technology based on current understanding is fusing hydrogen (^{1}H) with boron (^{11}B) usually referred to as "p-^{11}B".[5] Another candidate similar to p-^{11}B may be D-^{3}He. There are many other fusion technologies under development in the US private sector economy primarily funded by venture capital.

Regardless the technology or technologies that ultimately prove viable, fusion technology is by far the safest CO_2-free energy technology available. It seems that the time is long past for the US DOE to focus funding on the most promising fusion technologies as opposed to SMR research. Both are valuable but much more research is required by fusion for high temperature magnets, first wall materials, tritium management, plasma confinement, and many other areas. If the consensus remains that CO_2 is causing significant ongoing damage to public health and safety, the sheer scale of the worldwide energy requirement indicates a pressing need for an inherently safe technology.[6] Fusion is the right answer – a John F. Kennedy "moon shot"-level vision and commitment is needed to make it a reality.[7]

Let's talk!
Ernie Kee, SERAD Editor

[2] See for example, https://www.iea.org/data-and-statistics/charts/world-total-final-consumption-by-source-1971-2019. Website accessed 11 September, 2022.

[3] Slides for January 26, 2021 Virtual Public Meeting on Developing a Regulatory Framework for Fusion Energy Systems, USNRC ADAMS Accession Number ML21026A315.

[4] The kinds of fusion technologies being explored have different challenges summarized by the Lawson criteria, the product of $n_e\, T\, \tau_E$. In this formulation of Lawson's figure of merit, n_e is plasma density, T is plasma temperature, and τ_E is confinement time.

[5] See for example, Gota, H., M. W. Binderbauer, T. Tajima, A. Smirnov, S. Putvinski, M. Tuszewski, S. A. Dettrick et al. "Overview of C-2W: high temperature, steady-state beam-driven field-reversed configuration plasmas." Nuclear Fusion 61, no. 10 (2021): 106039.

[6] A recent article is Rennert, Kevin, Frank Errickson, Brian C. Prest, Lisa Rennels, Richard G. Newell, William Pizer, Cora Kingdon et al. "Comprehensive evidence implies a higher social cost of CO2." Nature 610, no. 7933 (2022): 687-692. and recent OMB Estimates.

[7] Conceptually, the President John F. Kennedy, address at Rice University, September 12, 1962.

SERAD Committee

Table 1. 2021–2022 SERAD Committee Membership

Executive Committee		Appointments	
Position	Person	Position	Person
Chair	Arun Veeramany	**Chair: Awards and Fellow Nomination Committe**	Mohammad Pourgol-Mohammad
1st Vice-Chair	Stephen.Ekwaro-Osire@ttu.edu	**Newsletter Editor**	Ernie Kee
2nd Vice-Chair-Treasurer	Mihai Diaconeasa	**Webinars / Outreach Chair**	Open
3rd Vice Chair-Membership	Andrey Morozov	**Student Program Coordinator**	Deivi Garcia
4th Vice-Chair-Secretary	Dr. Alba Sofi	**Track Co-Chairs**	Mihai Diaconeasa Ernie Kee John Wiechel Alice Sun
Past Chair	Xiaobin Le, Ph.D., PE	**Technical Content Coordinator**	Giulio Malinverno
IMECE 2022 Track Chair	Bill Munsell	**IMECE 2022**	Andrey Morozov