European Safety and Reliability Association

Newsletter

http://www.esrahomepage.eu

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Editorial

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Dear ESRA Colleagues!

The 29th yearly conference of ESRA was organised in Hannover Germany, September 22-26, 2019. The conference location was Welfenschloss, the building of the Leibniz Universität Hannover.

The program of the conference included 5 keynote lectures given by the world known experts.

Plenary Lecture 1: Recent Advancements in Risk Analysis and Management, Terje Aven.

Plenary Lecture 2: Managing Uncertain Ground Truth Using Bayesian Machine Learning, Kok Kwang Phoon.

Plenary Lecture 3: Probability Density Evolution – a Unified Perspective for Engineering Reliability Analysis of Structures and Lifeline Networks, Jie Li.

Plenary Lecture 4: An Introduction to Sliced-Normal Distributionsm, Luis Crespo.

Plenary Lecture 5: Prediction and Decision Making from Bad Data, Scott Ferson.

In addition, the conference included 14 sessions with 10 parallel tracks for a total of 590 papers selected after the peer-review, covering 19 methodological fields and 23 application areas related to the ESRA technical committees and wider.

More than 600 participants from more than 40 countries shared their thoughts and experience through the conference activities.

The papers were published in open access proceedings for the first time in the series of ESREL conferences: Proceedings of the 29th European Safety and Reliability Conference edited by Michael Beer and Enrico Zio.

The main organisers did their job very well: Michael Beer, Conference General Chair, Enrico Zio, Conference General Co-Chair, Edoardo Patelli, Technical Committee Chair, Stefan Bracke, Technical Committee Chair, Matteo Broggi, Local Organizing Committee Chair, Jasper Behrensdorf, Local Organizing Committee Co-Chair, Julian Salomon, Local Organizing Committee Co-Chair.

The financial support by the German Research Foundation, under Grant No. BE 2570/9-1, and by industrial sponsors, Großraum-Verkehr Hannover GmbH, Exida, and Satodev is appreciated and contributed to a better conference.

In parallel to the conference, the ESRA assembly was organised. In addition to the regular activities of the assembly, which are scheduled every year, the election of new ESRA secretary was scheduled and Roger Flage was elected again.

The assembly selected the organiser of ESREL 2021, which is Bruno Castanier, University of Angers, France, who is going to conduct the organisational aspects of the conference.

In parallel, the ESREL2020 conference in Venice, June 21-26, 2020, which is joined with PSAM15 conference is well on its way accepting abstracts. We wish Enrico Zio and Terje Aven as chairs of the conference a success. We count on technical programme committee chairs: Piero Baraldi, Francesco Di Maio and Johan Sörman to organise a fruitful programme attracting many participants.

ESRA Chairman
Marko Čepin

Feature Articles

Reliability by design for underwater robots

Mario Brito
University of Southampton,
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Introduction

The European funded Horizon 2020 project Bringing together Research and Industry for the Development of Glider Environmental Services (BRIDGES) aim was to develop two underwater gliders, denoted as the Deep glider and the Ultra-Deep glider (http://www.bridges-h2020.eu/).

In the absence of operational data, the reliability prediction for the BRIDGES glider had to be informed by the BRIDGES glider functional design and operational requirements. A fault tree presents a suitable approach to analyse the effects of individual, or a combination of failure modes on the likelihood of mission abort. The probability of observing the undesirable event in a given time can be converted into a mean time between failures (MTBF) for the system. Using a suitable reliability profile it is possible to estimate the probability of an abort for different mission's lengths. In this newsletter, I show how these methods were used to calculate the underwater robot risk.

Methods

In practice, sea trials are conducted prior to any science mission. This enables the engineering team to identify and correct faults caused by early manufacturing faults or design errors. Therefore, a constant failure rate can be assumed for the BRIDGES underwater glider science missions. The exponential reliability function assumes a constant failure rate; as such, it is a suitable function to represent the BRIDGES glider reliability profile.

The exponential reliability function is calculated using Equation 1, where MTBF stands for mean time between failures.

$$R(t) = e^{-\frac{1}{MTBF}t} \quad 1.$$

The problem is that the MTBF is not known for a new robot. However, if we know the reliability, R(t), at given time t, it is possible to calculate the MTBF.

$$MTBF = \frac{-t}{\ln(R(t))} \quad 2.$$

Fault trees allow us to model the aggregate effect of individual failure modes on the undesirable hazardous event. Figure 1, presents the high level fault tree model for estimating the probability of mission abort.The reliability, R(t) is the complement of the probability of abort. The fault tree for a mission abort is very different from a fault tree for a robot loss. A mission abort can be caused by failure of a critical system, such as the pitch control system, buoyancy control or others. However a critical system failure on its own may not lead to its loss. For example, in open water, a failure of the pitch control system would have to be combined with a failure of the buoyancy control system and a failure of the safety weight system in order to result in robot loss.

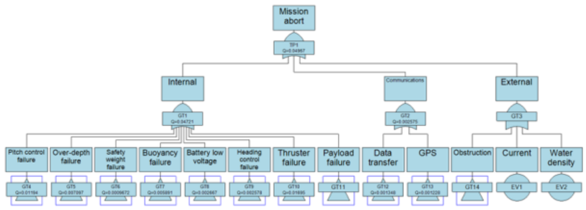

Figure 1. High-level fault tree model for BRIDGES glider mission abort.

Expert judgment elicitation

Expert judgment elicitation has a proven record of providing reliable quantification of risk for autonomous underwater missions. The probabilities of failure leading to abort for all failure modes in the fault tree were quantified based on the formal expert judgment. The elicitation process is described by O'Hagan et al [1]. The phases of the EEJ process are summarised below.

- **Define the question in detail.** The specific question that the experts were asked to answer was "What is the probability of failure X leading the BRIDGES glider abort in 3-month mission?", where failure X is failure of one of the basic fault events present in the fault tree model.
- **Expert selection.** Experts were selected, based on their experience with the *SEA Explore*r underwater glider. We sought to obtain a wider representation of skills, such as battery design, command and control and others.
- **Expert training.** The experts were asked to answer three seed questions. Autosub6000 failure data has been presented in a report which was not visible to the public at the time of the elicitation [2]. The three questions asked: What is the probability of GPS failure per km? What is the probability of a battery failure on Autosub6000 per km? What is the probability of a stern actuator failure on Autosub6000 per km? The experts were informed that Autosub6000 had conducted 68 missions and that the total distance covered by the autonomous underwater vehicle (AUV) was 3650kms.

Analysis and results

Nineteen different distributions were agreed by the panel. Table 1, below, presents the 95% quantile, for the probability of each fault leading to premature glider abort.

The results show that failure of the buoyancy pump high pressure, break failure of the moving mass, Spindle drive failure, air bladder failure, rudder actuator failure and thruster actuator are the six most critical failures.

Table 1. Independent failure modes aggregated risk assessments. 95% quantile of the probability of failure leading to abort.

Failure mode	**95% Quantile**
24	2.40×10^{-3}
4,5	2.08×10^{-3}
31	1.20×10^{-3}
51	3.64×10^{-4}
1, 3a, 3c, 8, 10, 12, 14, 18, 41, 42, 43, 50, 54, 55, 64, 67	3.03×10^{-4}
16, 23	2.74×10^{-4}
26	1.72×10^{-4}
52	3.50×10^{-4}
11, 28, 32,34,49	1.20×10^{-4}
53, 63,65	8.64×10^{-5}
20, 40, 48, 57,60,2, 3b	3.03×10^{-5}
13, 22,33	4.07×10^{-5}
61	4.41×10^{-5}
27	1.72×10^{-5}
7, 15,19, 62,66	3.50×10^{-5}
44	3.99×10^{-5}
39	1.76×10^{-5}
6,29	8.00×10^{-6}
9,68	3.50×10^{-6}

Based on the fault tree analysis, the probability of premature mission abort for the UD glider, with buoyancy-based propulsion is 0.0333; therefore, the MTBF for the UD glider is 7.5 years. The probability of premature mission abort for the UD glider 0.0497; therefore, the MTBF for the UD glider with propelled based propulsion is 5 years.
The exponential survival distribution for the BRIDGES glider is presented in Figure 2.

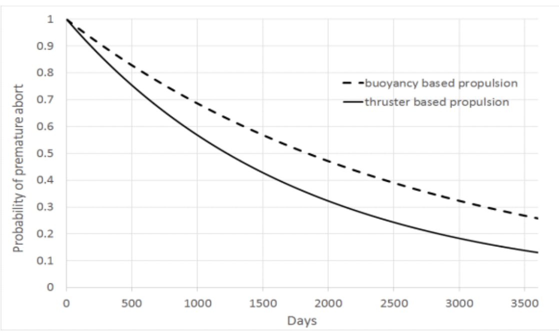

Figure 2. Reliability profile for the BRIDGES glider considering buoyancy-based propulsion and thruster-based propulsion.

The buoyancy-based propulsion presents a more reliable way to navigate. This type of propulsion has proven reliable for commercially available underwater gliders, such as the Slocum, the Seaglider, and the Sea Explorer [3][4].

Conclusions

The probability of premature mission abort for the UD glider of 0.97, for a 90 day mission is comparable to the probability to mission abort for the Spray underwater glider of 0.95 for a 100 day mission [2].
Both risk profiles do not consider payload failure. Also, of some relevance is that both risk profiles assume that the developer is the operator and that a burn-in time is implemented. This does not validate the estimates of the BRIDGES risk profile, but the results are nevertheless encouraging.

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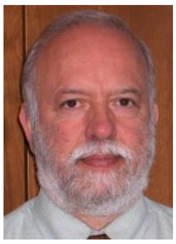
RESS News



Carlos Guedes Soares
Editor-in-Chief RESS
Instituto Superior Técnico,
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Sensitivity Analysis of Model Output

The special issue on “Sensitivity Analysis of Model Output” has been published in the July 2019 issue. This special issue was guest edited by Thierry A. Mara, from France and Stefano Tarantola from Italy, to whom go our thanks for the excellent work performed. The issue has covered diverse topics related with the general area and I hope this can promote the representation of these topics in the journal.
According to the Guest Editors, “sensitivity analysis of model response is acknowledged as an essential ingredient of modelling and is nowadays widely used in different disciplines that heavily lean on model

simulations. This is explained by the fact that uncertainty and sensitivity analyses add to the quality of model-inferences and contribute to the responsible use of models for decision-making."

So it becomes clear that sensitivity analysis of model response contributes to decision making under uncertainty, an important topic related with system safety.

"There are now different statistics proposed in the literature to measure the importance or non-significance of uncertain model inputs for model responses. They can be classified loosely as either variance-based sensitivity indices (also called Sobol' indices), derivative-based sensitivity indices or moment-independent importance measures." These various methods have been covered in the 14 papers that make up this special issue.

Most of the papers come from the SAMO International Conference on Sensitivity Analysis of Model Output, which has a very focused aim on the topic of the special issue and which has traditionally been contributing to RESS with these special issues.

PhD Degrees Completed

Robust Computational Frameworks for Power Grid Reliability, Vulnerability and Resilience Analysis

Roberto Rocchetta
Supervisor: Edoardo Patelli
Co-supervisors: Matteo Broggi, Sven Schewe, Enrico Zio
Institute for Risk and Uncertainty
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Research overview

The Power Grid is the world's largest, man-made interconnected structure and plays a critical role in the well-being of society. The working productivity, comfort and safety of local citizens relies on Critical Infrastructures (CIs) which are partially of fully dependent on the power grid integrity. Thus, even modest power outages can seriously compromise the welfare of a community. Quantifying accurately the availability, reliability and vulnerability of the network is thus of paramount importance. Furthermore, the power grid is a complex dynamic system affected by stochastic time-space dependent power loads and (due to the increasing allocation of renewable energy generators) uncertain time-varying power production sources. This poses several challenges from the modelling, analysis and optimization perspective especially considering environmental changes, which are drifting weather scenarios towards extremes. Hence, also the resilience (i.e., the ability to withstand high impact-low probability events, rapidly recovering and improving operations and structures) is becoming a major concern for the future power grids and CI.

In this wide context, the thesis proposed an original ensemble of advanced computational approaches for the rigorous and efficient assessment of the reliability, robustness and resilience of critical infrastructures (specifically, smart power grid systems), in the presence of uncertainties [1-5]. Uncertainty is an unavoidable component of power grid behavior and modeling and can be due to: (i) the inherent variability of the system (e.g., randomness in the power load profiles); and (ii) the (possibly) imprecise knowledge of the analyst about the system itself and the physical phenomena involved (e.g., because of scarcity of data and/or inconsistent information). Both types of uncertainty need to be accurately represented and quantified for a realistic assessment of the network performance. In this view, the authors have developed a robust framework for uncertainty treatment, based on both (traditional) probabilistic and (innovative) non-probabilistic approaches (e.g., interval analysis, fuzzy and evidence theories). The power of non-probabilistic methods is that – different from traditional ones – they have a limited need for artificial model assumptions when the available data is scarce. Those assumptions might alter the quality of the available information, produce severe underestimations of risk and reduce, correspondingly, the validity of safety-critical decisions.

It is worth noting that the uncertainty thereby represented needs to be propagated through the model of a the critical infrastructures (e.g. a power grid simulator) onto the final reliability, robustness and resilience metrics of interest to the analysis. Unfortunately, this requires considerable and often prohibitive computational efforts: actually, several (burdensome) model simulations (i.e., several power flow analyses) are required, in order to characterize the response of the power grid in correspondence of different, uncertain conditions. To address this issue, the thesis explores the use of fast-running surrogate models (also known as emulators or meta-models), i.e., of numerically cheap mathematical approximations of the computationally expensive realistic power flow model. Artificial Neural Network (ANN) have been proposed to emulate the relation between load curtailments, lines states vectors and load profiles. The proposed model is shown to reduce substantially the computational time while keeping a satisfactory level of accuracy and precision in the model estimates [1].

One of the key elements for a reliable, robust and resilient critical infrastructure is the system ability to adapt and learn from past events, possibly improving its structure, operations and decision-making policies. To better understand the role of this key element in the future of resilient power grid systems, Roberto's Ph.D. thesis also investigated a Machine Learning framework for optimal decision-making in uncertain environments [2]. A non-tabular Reinforcement Learning framework combining the Q-learning algorithm and enables of ANNs is proposed to equip power grids with learning capability. Existing power grid maintenance and operational policies have been updated and optimized based on newly observed pieces of evidence, which is a fundamental element of the resilience concepts.

The developed frameworks can be used to investigate the effect of severe scenarios (such as extreme weather conditions, multiple contingencies and cascading events) on the grid safety performance [3].

Roberto's thesis has addressed several theoretical, computational and practical issues related to the robust assessment of the reliability [4], vulnerability [3], adaptability [2] and resilience of power networks [1]. Each issue has been tackled in a rigorous way by studying and originally developing advanced computational techniques, which may provide a valuable contribution to the research community and industrial practitioners. The developed computational tools has been integrated in the open source software for uncertainty quantification OpenCossan [6] available at www.cossan.co.uk.

Roberto's Ph.D thesis is available at:
http://livrepository.liverpool.ac.uk/id/eprint/3034529

Current position

Roberto Rocchetta is now a Research Scholar at National Institute of Aerospace (NIA). He is involved in a collaborative research effort with the Dynamic Systems & Control Branch at the Langley National Aeronautics and Space Administration (NASA). His research primarily focuses on the development of methods for: (i) efficient reliability assessment of complex systems and critical infrastructures affected by uncertainty; (ii) Reliability-based Design Optimization (RBDO) by means of imprecise probabilistic approaches, given-data methods, and distribution-free approaches; (iii) modelling of stochastic and structural dependencies.

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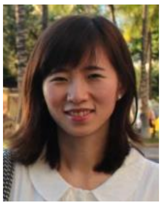
Assessment of Cascading Failures Risks and Development of Mitigation Strategies



Bing Li
Supervisor:
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Large-scale interconnectivity has become an inevitable trend in electric power transmission systems. However, the capability of power grids to transfer power over long distances accrues the risks that local failures can propagate to the entire network. Furthermore, the increasing penetration of renewable energy in the electricity markets and the adoption of the smart grid concept are leading to higher complexity and uncertainty in the power infrastructure and in its operations, possibly unlocking unprecedented failure phenomena. The aim of the PhD thesis is to further our understanding of the vulnerabilities and risks of cascading outages existing in electric power systems and stemming from the integration of electric power systems with other infrastructures and economic sectors, in order to guide the safe operation of energy networks and future investment in the electric power systems. The original research activities include the development and validation of computational tools for analyzing and simulating the failure behavior in power systems, the evaluation of protective measures for mitigating the cascading failures and the quantification of the impact of the interdependent infrastructures and of economic operations on the security of the power grid.

To provide insights into the complex nature of operation characteristics of electric power systems, we propose cascading outages simulation models at different levels of model details, i.e., a DC power flow-based model and an advanced approximate AC power flow-based model. The models analyze the evolution of failures in cascading events and quantify the loss when cascading outages terminate. Furthermore, we introduce a linear AC power flow algorithm, which finds a compromise solution between the computational expensive AC power flow and the simplified DC power flow. The capabilities of the models are compared. The results demonstrate that the DC power flow estimates are biased towards overly optimistic outcomes, which may possibly provide the operator with a skewed assessment of the cascade risks. Conversely, the linear AC method provides a good approximation of the AC power flow solution and its computation time does not increase significantly compared to the DC power flow.

The credibility of cascading failures models is undermined by their lack of validation usually blamed to data scarcity and not repeatable testing conditions in such large infrastructures. We are currently active in one of the first few validation studies for cascading failure models. An algorithm is developed for the calibration and the validation of the cascading failure analysis based on meta-heuristic optimization. The model parameters are optimized through minimizing the differences between the simulation results and the historical blackout data. We analyze the Western Electricity Coordinating Council (WECC) system, Swiss system and their historical outage data, and we are able to replicate the statistics of the blackout size to a good extent. This experiment paves the way for further validation efforts and for strengthening the credibility of the risk assessment of cascading failures.

We conduct investigations on the approaches for mitigating the risk of cascading line outages and utilize the cascading outages simulation model to test their effectiveness under various critical scenarios. A sensitivity-based control approach is proposed for line overloads elimination in the cascading events. The framework aims at finding a compromise solution, which minimizes the redispatch power and the redispatch time. The solutions identified with the sensitivity-based method are compared with the solutions from the standard OPF to illustrate how the heuristic approach can be used to support the dispatcher's decision making by providing further corrective actions alternative to standard OPF.

Failures in the electric power infrastructure not only cause the disruption of the power supply but also result in losses in productivity across other dependent industries. To address the societal impact of the blackouts, we uniquely integrate the cascading failure analysis for the electric network with a multi-regional, multi-industry interdependency model to quantify the short-term economic impacts of electric power disruption. The application of the analysis to the Swiss economy demonstrates the significance of including societal consequences as additional metrics for measuring the vulnerability of a system and the criticality of economic sectors, regions and components in the infrastructure.

Figure 1 illustrates the regional risk of Demand Not Served (DNS) and regional risk of economic losses caused by cascading failure simulations, it is obviously that the power supply robustness of each region is ranked differently based on the risk of DNS and on the risk of economic losses.

Building on the specific findings of this dissertation, future work can be pursued in the following directions: (i) the modeling of operator's intervention can be included in the cascading failure analysis to evaluate the effects of human factors on the consequence of cascading events. (ii) One significant limitation of linear AC power flow is that it cannot directly represent voltage collapse because the linear AC model should always solve. Finding a way to approximate the effect of voltage collapse via some sort of proxy in the linearized model in future work would further enhance the power of this modeling advance. (iii) The sensitivity factors employed in inter-subnetwork power shifts to mitigate cascading failures are based on DC power flow method, which assumes a constant voltage profile and omits the reactive power flow. Future work will explore the extension of the framework to include the effects of reactive power flows.

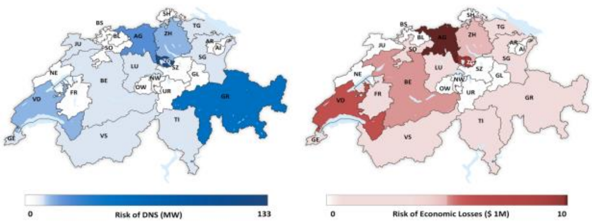

Figure 1. The geographical distribution for risk of DNS (left) and risk of economic losses.

Calendar of Reliability and Safety Events

7th International Conference on Risk Analysis and Crisis Response (RACR, 2019)

15-19 October, 2019

Athens, Greece

We are pleased to announce and invite you to participate in the 7th International Conference on Risk Analysis and Crisis Response (RACR 2019).

RACR, launched by the Risk Analysis Council of China Association for Disaster Prevention in 2007 and taken over by SRA-China since 2011, is a series of biennial international conferences on risk analysis, crisis response, and disaster prevention for specialists and stakeholders.

In the Internet age, more and more data can support a large number of models for risk analysis. The simple, transparent, and reliable risk models are been favored by researchers. The assessment of integrated risks in complex systems is towards practical use. Risk analysis

based on data is winning subjective judgment. Meanwhile, the world is increasingly turbulent. The black-swan events occur more frequently, and a crisis of undercoordination, such as the debt crisis of 2008, might suddenly erupt. Crisis response beyond knowledge is increasingly testing people's intelligence.
RACR provides a unique international forum to discuss these issues from a scientific and technical point of view and also in terms of management, services or usages.RACR provides a unique international forum to discuss these issues from a scientific and technical point of view and also in terms of management, services or usages.

Theme: Risk Analysis Based on Data and Crisis Response Beyond Knowledge

Conference Topics

1. Applying Risk Science based on data
2. Stakeholder engagement to manage risks
3. Risk analysis related to black-swan events
4. Responding to a crisis of undercoordination
5. Reliability and safety in industrial systems
6. Modern trends in crisis management
7. Internet of Intelligences and risk radar
8. Nanotechnology safety
9. Safety in transport domain
10. Progress in occupational health and safety
11.Natural Hazards inducing tech. accidents (NATECHs)
12. Human Factors in the industrial environment
13. Life-cycle analysis of units
14. Legal aspects in Major Accidents Prevention
15. Disaster risks in line with “Belt and Road”
16. Risk analysis in project investment and finance
17. Risk analysis related to black-swan events
18. Terrorist attack and crisis response

Conference Venue: National Center for Scientific Research “Demokritos”

Conference Website:
https://mssg.ipta.demokritos.gr/racr2019/#

Contact Information: racr2019@ipta.demokritos.gr

5th Nordic Chapter of the Society for Risk Analysis (SRA Nordic) Conference - Risk Management for Innovation

6-8 November 2019
Copenhagen, Denmark

The Nordic Chapter of the Society for Risk Analysis (SRA Nordic) invites you to its fifth conference that will be held in Copenhagen.
The objective of the SRA Nordic 2019 conference is to provide a multi-disciplinary forum for the exchange of knowledge and expertise on theories, methods and practices in the field of risk management within the Nordic and Baltic countries (Denmark (incl. Greenland), Faroe Islands, Finland, Norway, Sweden, Iceland, Latvia, Lithuania, and Estonia).
The conference will bring together the Nordic and Baltic research community on Risk Analysis of innovative products and technologies. The target audience are academics and practitioners interested in the assessment, characterization, communication, management and policy of the risks connected to innovation, such as risk to human health, the environment and other. The conference will be the breeding ground for student participants. Events such as a poster session and career development opportunities will enable student participants to build a strong network within the community.

Contribution types: Abstract and Posters. Abstracts for oral and poster presentations as well as workshops must be prepared by using the provided templates.
Call for abstracts
SRA Nordic invites abstract submissions for oral and poster presentations. We also invite submissions for workshop proposals.

Important Deadlines:
Deadline for submissions: 15th August 2019

Deadline for registration: 15th October 2019

Contact Information: RA_Nordic_2019@man.dtu.dk

Conference Venue: IDA Conference Centre, Kalvebod Brygge 31-33 1780 Copenhagen V.

Conference Website: www.risklab.dtu.dk/sra-nordic-2019/

XXII Edition of the course: “RAM&PHM 4.0: Advanced methods for Reliability, Availability, Maintainability, Prognostics and Health Management of industrial equipment

9-12 December 2019
Milan, Italy
Author: Francesco Di Maio

The 2019 professional one-week training course: “RAM&PHM 4.0: Advanced methods for Reliability, Availability, Maintainability, Prognostics and Health Management of industrial equipment” will take place at Politecnico di Milano, Milan (Italy) on December 9-12.
The course will be the XXII edition of the series. The course is stimulated by the evidence that, in recent years, the volume of data and information available in the industry has been growing exponentially and more sophisticated and performing analytics have been developed to exploit them. This exciting situation offers great opportunities of optimized, safe and reliable productions and products, including optimal predictive maintenance for “zero-defect” production, with reduced warehouse costs and improved system availability with “zero unexpected shutdowns”. To

grasp some opportunities, new system analysis capabilities and data analytics skills are needed.
The goal of the course is to provide participants with advanced methodological competences, analytical skills and computational tools necessary to effectively operate in the areas of reliability, availability, maintainability, diagnostics and prognostics of industrial equipment. The course presents advanced analytics to improve safety, increase efficiency, manage equipment aging and obsolescence, set up condition-based and predictive maintenance.
Since the beginning, the course has been officially supported by ESRA and since 2005 official scholarships have been offered. The 2018 edition of the course has been supported by ESRA with two scholarships covering the registration fee. The 2018 scholarships have been offered to two Ph.D students, one of Politecnico di Milano (Milano, Italy) and the other of the University of Liverpool (Liverpool, UK).
The first part of the course is devoted to the presentation of advanced methods for the availability, reliability and maintainability analysis of complex systems and for the development of Prognostics and Health Management (PHM) and Condition-Based Maintenance (CBM) approaches. In this respect, the basics of Monte Carlo Simulation, nonlinear regression and filter models (Artificial Neural Networks, Principal Component Analysis, Auto-Associative Kernel Regression, Ensemble Systems, Hilbert Huang and Wavelet transforms) and evolutionary optimization methods (Genetic Algorithms) are illustrated. In the second part of the course, exercise sessions on Monte Carlo simulation, Artificial Neural Networks and Genetic Algorithms provide the participants with the opportunity of directly applying the methods to practical case studies. Finally, in the last part of the course, real applications of the advanced methods illustrated in the course are presented. The applications range from the evaluation of maintenance costs taking into account the reliability and availability of equipment, to the application of Monte Carlo Simulation for system availability analysis and condition-based maintenance management, to the use of regression and classification techniques for fault detection, classification and prognosis in industrial equipment.
The European Safety and Reliability Association (ESRA)) supports the course with two scholarships to be awarded to PhD students. Scholarships will be assigned considering the affinity of the research to the topics of the course, the quality of the CV and the number and impact of publications in the field.

Course program chair:
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ESREL 2020 PSAM 15
21-26 June 2020
Venice, Italy

Don't miss the opportunity to contribute and participate to ESREL 2020 PSAM 15, the TOP conference in 2020 on Safety and Reliability. The Conference combines the 30th European Safety and Reliability Conference and the 15th Probabilistic Safety Assessment and Management Conference, and will be held in Venice, Italy, at Palazzo del Cinema, from June 21 to June 26, 2020. It will be a unique World Exposition (a real "Expo Tech") of scientific methodologies and technical solutions for the reliable design and operation of components and systems, for the prevention and management of risk in complex systems and critical infrastructures.
This Conference takes place only every eight years (Crete 1996, Berlin 2004, Helsinki 2012... and now Venice 2020) and brings together the TOP experts of the World in the science and practice of reliability and safety. It is a unique opportunity to advance knowledge in all fields of reliability and safety, by sharing achievements and challenges.
It provides a forum where to strengthen the multidisciplinary network of competent professionals, which is needed to face today's challenges in our rapidly evolving "risky" World: come and contribute to making it safer.
It is for contributing to the developments in the direction of a smart and sustainable World that you are invited to participate as main actor to the ESREL 2020 PSAM 15 Expo Tech Conference.
The online submission system is now open and you can submit your abstract at http://esrel2020-psam15.org/authors.html.

Important Dates:

Abstract Submission: 2nd December2019

Abstract Acceptance: 5th December 2019

Full Paper Submission: 15th January 2020

Acceptance Notification: 1st March 2020

Final Revised Full Paper Submission: 15th March 2020

Author Early-Bird Registration Closure: 15th March 2020

For more information visit the conference website : www.esrel2020-psam15.org

39th International Conference on Ocean, Offshore and Arctic Engineering (OMAE 2020) - Symposium on Structures, Safety and Reliability
28 June - 3 July 2020
Fort Lauderdale, USA

OMAE 2020 is the ideal forum for researchers, engineers, managers, technicians and students from the scientific and industrial communities from around the world to meet and present advances in technology and its scientific support, exchange ideas and experiences while promoting technological progress and its application in industry, and promote international cooperation in ocean, offshore and arctic engineering.

Following the tradition of excellence of previous OMAE conferences, more than 900 technical papers are planned for presentation.

The OMAE Congress in organised in about 11 Symposia each dealing with specific topics. The Structures, Safety and Reliability Symposium, as the name suggests, deals with offshore structures safety and reliability, having typically between 100-150 papers. Typical sessions include Probabilistic and Spectral Wave Models, Probabilistic Response Modelling, Reliability of Marine Structures, Fatigue Reliability, Reliability of Mooring and Risers, Reliability Renewable Energy Devices, Risk based Maintenance planning and Risk Analysis & Safety Management.

Conference Chair:
Professor Manhar R. Dhanak
Institute for Ocean and Systems Engineering, Florida Atlantic University, USA
Conference Co-Chair:
Professor Ronald W. Yeung
University of California, USA
Technical Program Chair:
Professor Antonio C. Fernandes
COPPE/URFJ LOC, Federal University of Rio de Janeiro, Brazil
Safety and Reliability Symposium Coordinator
Professor Carlos Guedes Soares
Instituto Superior Técnico Universidade de Lisboa, Portugal

Contacts:
Specific questions can be addressed to the **Safety and Reliability Symposium Coordinator** at:
c.guedes.soares@centec.tecnico.ulisboa.pt
Conference Website: https://event.asme.org/OMAE

11th IMA International Conference on Modelling in Industrial Maintenance and Reliability (MIMAR)

14 - 16 July 2020
Nottingham, UK

You are warmly invited to participate at the 11th IMA International Conference on Modelling in Industrial Maintenance and Reliability (MIMAR), which will take place in Nottingham, in the UK from 14-16 July, 2020.

Conference Chair:
Rasa Remenyte-Prescott, University of Nottingham, UK

Conference Co-Chair:
John Andrews, University of Nottingham, UK
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Phuc Do, University of Nottingham,UK

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Jin Wang, Liverpool John Moores University, UK
Min Xie, City University of Hong Kong, China
Enrico Zio, Politecnico di Milano, Italy
Ming J Zuo, University of Alberta, Canada

Important Deadlines:

Abstracts of 100-200 words via https://my.ima.org.uk: 2nd March 2020

Notification of abstract acceptance: 16th March 2020
Optional paper submission for conference proceedings: 15th May 2020
Final deadline for acceptance for conference proceedings:15th June 2020

Submission of extended papers for consideration for fully refereed special issue of Journal of Risk and Reliability: 1st November 2020

Contact Information: conferences@ima.org.uk
Conference Website: https://ima.org.uk/12183/11th-ima-international-conference-on-modelling-in-industrial-maintenance-and-reliability-mimar/

ESRA Information

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1. ESRA Membership

1.1 National Chapters

- French Chapter
- German Chapter
- Italian Chapter
- Polish Chapter
- Portuguese Chapter
- Spanish Chapter
- UK Chapter

1.2 Professional Associations

- The Safety and Reliability Society, UK
- Danish Society of Risk Assessment, Denmark
- SRE Scandinavia Reliability Engineers, Denmark
- ESReDA, France
- French Institute for Mastering Risk (IMdR-SdF), France
- VDI-Verein Deutscher Ingenieure (ESRA Germany), Germany
- The Netherlands Society for Risk Analysis and Reliability (NVRB), The Netherlands
- Polish Safety & Reliability Association, Poland
- Asociación Española para la Calidad, Spain

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- TAMROCK Voest Alpine, Austria
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- Bureau Veritas, France
- INRS, France
- Total, France
- Commissariat á l'Energie Atomique, France
- DNV, France
- Eurocopter Deutschland GMbH, Germany
- GRS, Germany
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- Atkins Rails, UK
- W.S. Atkins, UK
- Railway Safety, UK
- Vega Systems, UK

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- University of Natural Resources & Applied Life Sciences, Austria
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3. Standing Committees

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The aim of this committee is to establish the general policy and format for the ESREL Conferences, building on the experience of past conferences, and to support the preparation of ongoing conferences. The members are one leading organiser in each of the ESREL Conferences.

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This committee has the responsibility of interfacing with Publishers for the publication of Conference and Workshop proceedings, of interfacing with Reliability Engineering and System Safety, the ESRA Technical Journal, and of producing the ESRA Newsletter.

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ESRA is a non-profit international organization for the advance and application of safety and reliability technology in all areas of human endeavour. It is an "umbrella" organization with a membership consisting of national societies, industrial organizations and higher education institutions. The common interest is safety and reliability.
For more information about ESRA, visit our web page at http://www.esrahomepage.eu
For application for membership of ESRA, please contact the general secretary Coen van Gulijk E-mail: c.vangulijk@hud.ac.uk.
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