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Editorial

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This special issue contains representative works presented at the ESREL 2020 PSAM 15 Conference, the 30th European Safety and Reliability Conference (ESREL 2020) and the 15th Probabilistic Safety Assessment and Management Conference (PSAM 15), jointly held remotely on November 1–5, 2020.

During the Conference, developments in methods and advancements in technical applications have been presented in the areas of reliable design and operation of industrial components and systems, and risk prevention and management of critical infrastructures. A total of 728 abstracts and papers have been selected for presentation through a peer-review process conducted by more than 130 Track Directors, who have organized the work of more than 800 reviewers. The program has been enriched by 10 plenary lectures offered by speakers of international excellence, 5 panels, 11 special sessions, and 2 innovation challenges.

The Conference works have covered 55 topics and 31 application areas and this special issue presents works selected specifically from the special sessions on Dependence and Common Cause Failures Modelling and Analysis, Dynamic Reliability/Risk Assessment, Industry 4.0 Reliability and Safety, Predictive Maintenance and Prognostics and System Health Management.

The manuscripts included in this special issue are the following:

1. "Is eliciting dependency worth the effort? - a study for the multivariate Poisson-Gamma probability model" by Rafael Schwarzenegger, John Quigley, and Lesley Walls;
2. "A New Gamma Degradation Process with Random Effect and State-Dependent Measurement Error" by Nicola Esposito, Agostino Mele, Bruno Castanier, and Massimiliano Giorgio;
3. "Collaborative Data-driven Reliability Analysis of Multi-state Fault Trees" by Parisa Niloofar and Sanja Lazarova-Molnar;
4. "Subset Simulation for Optimal Sensors Positioning based on Value of Information" by Seyed Mojtaba Hoseyni, Francesco Di Maio, and Enrico Zio;
5. "Towards a Framework for Risk Monitoring of Complex Engineering Systems with Online Operational Data: A Deep Learning-Based Solution" by Ramin Moradi, Andres Ruiz-Tagle Palazuelos, Enrique Lopez Droguett, and Katrina M Groth;
6. "Safeguards Identification in Computer Aided HAZOP Study by Means Of Multilevel Flow Modelling" by Jing Wu, Mengchu Song, Xinxin Zhang, and Morten Lind;
7. "Simulation-based dynamic probabilistic risk assessment of an internal flooding-initiated accident in nuclear power plant using THALES2 and RAPID" by Kotaro Kubo, Xiaoyu Zheng, Yoichi Tanaka, Hitoshi Tamaki, Tomoyuki Sugiyama, Sunghyon Jang, Takashi Takata, and Akira Yamaguchi;
8. "The Aramis Data Challenge to Prognostics and Health Management Methods for Application in Evolving Environments" by Piero Baraldi, Michele Compare, Enrico Zio, Francesco Cannarile and Zhe Yang;
9. "Joint optimization of inspection and maintenance strategy for complex multi-component systems using a quantum-inspired genetic algorithm" by Diyin Tang, Xuan Wang, Junwei Di, Guofeng Zheng, and Jinsong Yu;
10. "Prognostic Considering Missing Data: An Input-Output Hidden Markov Model-Based Solution" by Kamrul Islam Shahin, Christophe Simon, Philippe Weber, Aslak Johansen, and Mikkel Baun Kjærgaard;
11. "A Comparison Between Computer Vision and Deep Learning-Based Models for Automated Concrete Crack Detection" by Beatriz Sales da Cunha, Marcio das Chagas Moura, Caio Souto Maior, Ana Claudia Negreiros, and Isis Didier Lins;
12. "Integrated planning framework for preventive maintenance grouping: A case study for a conveyor system in the Chilean mining industry" by Pablo Viveros, Rodrigo Mena, Enrico Zio, Leonardo Miqueles, and Fredy Kristjanpoller.

In the first paper of this special issue by Rafael Schwarzenegger, John Quigley, and Lesley Walls, the

authors examine whether it is worthwhile eliciting subjective judgments to account for dependency in a multivariate Poisson-Gamma probability model. A simulation study investigates the impact of different degrees of dependency on the estimation error, thus allowing the quantification of the consequence of a dependency mis-specified by subjective judgment.

The second paper by Nicola Esposito, Agostino Mele, Bruno Castanier, and Massimiliano Giorgio presents a new gamma-based model of the degradation process, which allows accounting for measurement errors whose magnitude depends on the component degradation level measured. The process parameters identification is performed by a likelihood maximization procedure that combines particle filtering with an expectation-maximization algorithm. The same particle filter is also used to compute the cumulative distribution function of the remaining useful life and the conditional probability density function of the hidden degradation level. The approach is operationalized on two numerical examples.

In the following paper by Parisa Niloofar and Sanja Lazarova-Molnar, an extended approach for collaborative Data-Driven Fault Tree Analysis (DDFTA) is proposed, which extracts repairable fault trees from time series data streaming acquired from multiple systems/machines sharing similar functionalities. For demonstration, the approach is applied to a system composed by different machines cooperating in the data collection phase.

In the work of Seyed Mojtaba Hoseyni, Francesco Di Maio, and Enrico Zio, a Subset Simulation (SS) method is originally proposed for maximizing the Value of Information (VoI) for equipment health monitoring by optimal sensors positioning. A real case study concerning the condition monitoring of a Steam Generator (SG) of a Prototype Fast Breeder Reactor (PFBR) is considered. Results show that SS, even if initialized with a small number of Monte Carlo samples, is capable of finding the optimal set of sensors positions in a very short computational time and is insensitive to the non-submodularity of VoI.

The paper by Ramin Moradi, Andres Ruiz-Tagle Palazuelos, Enrique Lopez Droguett, and Katrina M Growth proposes a mathematical architecture that integrates fault trees, as the system-level modeling method, and Deep Learning (DL), as the components condition monitoring method, for dynamic risk assessment of complex engineering systems. The applicability is shown on a real-world mining stone crusher system.

Jing Wu, Mengchu Song, Xinxin Zhang, and Morten Lind propose Multilevel Flow Modelling (MFM) as a knowledge representation method for Hazard and Operability Studies (HAZOPs). To illustrate the method, the MFM model of a typical oil and gas process module is extended to support the related HAZOP study.

The paper by Brian Cohn, Todd Noel, Douglas Osbor, and Tunc Aldemir presents a novel Leading Simulator/Trailing Simulator (LS/TS) method to integrate multiple generic safety and security computer models into a single, holistic safety-security analysis of nuclear power plants.

In the paper by Kotaro Kubo, Xiaoyu Zheng, Yoichi Tanaka, Hitoshi Tamaki, Tomoyuki Sugiyama, Sunghyon Jang, Takashi Takata, and Akira Yamaguchi, a simulation-based dynamic probabilistic risk assessment for internal flooding-initiated accidents in nuclear power plants is proposed and applied to the internal flooding of the turbine building of a pressurized water reactor.

The paper by Piero Baraldi, Michele Compare, Enrico Zio, Francesco Cannarile, and Zhe Yang presents the Aramis Data Challenge on "Degradation state assessment in evolving environments," that was launched for the ESREL2020-PSAM15 conference: the associated public dataset, the solution methods proposed by the Challenge participants and the related results obtained are illustrated in details in the paper.

The paper by Diyin Tang, XuanWang, Junwei Di, Guofeng Zheng, and Jinsong Yu presents a method for the joint optimization of inspections and maintenance strategies for complex multi-component systems, that uses a quantum-inspired genetic algorithm. To demonstrate the effectiveness and advantages of the proposed method, the algorithm is tested on an electro-optical system and the results are compared with traditional intelligent optimization algorithms.

Kamrul Islam Shahin, Christophe Simon, Philippe Weber, Aslak Johansen, and Mikkel Baun Kjærgaard propose an Input-Output Hidden Markov Model (IOHMM) for Residual Useful Life (RUL) estimation in case of missing data. The benefit of extracting as much information as possible from the incomplete data sequences is shown on a synthetic data case study.

Kamrul Islam Shahin, Christophe Simon, and Philippe Weber present an IOHMM to estimate the system RUL in real time. The method is able to learn the impact of the operating conditions on the RUL from the available information and it allows managing the system degradation by changing the operating conditions. A numerical example is presented.

In the paper by Beatriz Sales da Cunha, Marcio das Chagas Moura, Caio Souto Maior, Ana Claudia Negreiros, and Isis Didier Lins, the authors compare computer vision- and deep learning-based models for automated concrete crack detection, using different metrics and different sizes of datasets of images.

The last paper in the special issue is by Pablo Viveros, Rodrigo Mena, Enrico Zio, Leonardo Miqueles, and Fredy Kristjanpoller. The work formulates the problem of planning preventive maintenance under the mixed-integer linear programming (MILP) paradigm, which allows minimizing the asset

unavailability considering several tolerance levels. A case study for a conveyor system in the Chilean mining industry is presented.

Finally, we, the guest editors, would like to thank the authors for their outstanding contributions and the reviewers for their timely and professional work. We also wish to acknowledge that this special issue would have not been possible without the kind support of Prof. Terje Aven, Editor-in-Chief of the Journal, who has given us the opportunity and the assistance necessary to put together such a collection of interesting works. To all the above colleagues goes our sincere professional appreciation and personal gratitude.

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