ICASP14

Schedule

Sunday, 9 July, 2023

16:00-17:00 Arts Concourse

Registration

Registration

17:30-19:00 Exam Hall

Welcome Reception

Session Chairs: Alan O'Connor, Vikram Pakrashi
Evening Event

Monday, 10 July, 2023

08:00-08:30 Arts Concourse

Registration

Registration

08:30-09:30 Ed Burke, Level 1

Opening Plenary

Session Chairs: Linda Doyle, Alan O'Connor, Vikram Pakrashi
Keynote Session

08:30-09:30 Robert Emmet, Level 2

Relay of Keynote Plenary

Keynote Session

09:30-10:00 Arts Concourse

Tea/Coffee Break

Tea/Coffee Break

10:00-12:00 Thomas Davis, Level 2

MS 19: Surrogate and Reduced Order Models

Parallel Session

Computer simulation has become central in all fields of engineering and applied sciences in the last decades. High-fidelity simulators (e.g. finite element models) are commonly used all along the design process of complex systems. However, using these models directly to optimize designs, to assess the impact of uncertainties on reliability and robustness, to pursue model calibration from experimental data or to carry out global sensitivity analysis is not feasible due to computational costs. For this reason, surrogate modelling has gained major interest in the recent years. The aim of this mini-symposium is to highlight new research trends in the field of surrogate modelling. Contributions on established techniques such as (sparse) polynomial chaos expansions, Kriging, support vector regression, sparse grid interpolation, etc. are welcome, but also data-driven approaches stemming from machine learning such as (deep) neural networks, random forests, etc. Topics of interest include, but are not limited to active learning, ensemble modelling, dimensionality reduction. Significant applications in new or emerging fields are also welcome.
Uncertainty quantification (UQ) of engineering structures remains a computationally expensive task, although significant achievements have been made in computing technology. UQ in forward and inverse problems requires solving a discretized version of the governing differential equation multiple times. This discretized differential equation often involves significantly large degrees of freedom, making UQ a computationally prohibitive task. This mini-symposium will focus on computational challenges and the recent development of numerical methods for UQ using reduced order modeling. The scope of the mini-symposium involves topics on uncertainty quantification, inverse problem, data-driven modeling using machine learning, reliability analysis, surrogate modeling, and reduced-order modeling. Applications of the developed methods to structural and fluid dynamical systems are also encouraged.

10:00-12:00 JM Synge, Level 2

MS 6: Optimal decision making under uncertainty

Parallel Session

Results from engineering assessments ultimately serve as decision support. Hence it is often relevant to set the assessments in the context of a formal decision analysis, to ensure an optimal choice of methods and interpretation of results. In addition, the advent of increasingly automated and autonomous systems that perform their own decision making requires new approaches and methods for quantifying and validating performance, safety, and reliability.
This mini-symposium aims at gathering researchers interested in developing and applying methods for optimal decision making under uncertainty for engineering systems. It focuses on optimization involving stochastic environments, objectives and constraints, and the integration of formal decision analysis with stochastic models, simulators, data analytics, and artificial intelligence methodologies towards long-term planning in complex settings. These include sequential decision processes but also decisions involving multiple stakeholders, among others. Selection of metrics for stochastic analysis based on decision-theoretic considerations are also of interest, such as the choice of appropriate objective functions and decision-theoretic sensitivity measures.

10:00-12:00 Robert Emmet, Level 2

MS 28: Structural Health Monitoring and Uncertainties in Modeling and Inspection

Parallel Session

Visual structural inspection remains the most commonly used method of investigating structural health, despite biased inspection results. Structural health monitoring (SHM), on the other hand, has been studied with the expectation that it will provide useful information for quantitative assessment of structural health and updating of structural models. However, due to the lack of satisfactory results in real-world conditions caused by uncertainties in mathematical modelling and sensing in SHM, it has not been widely accepted by the authorities.
The scope of this mini-symposium is to bring together experts, researchers, academics and practicing engineers concerned with the various aspects of SHM and uncertainties in modeling and inspection. Contributions addressing developments in the theoretical, and computational approaches as well as practical applications are invited.

10:00-12:00 Jonathan Swift, Level 2

MS 25: Information Value and Decision Analyses

Parallel Session

Actual scientific, societal and industrial challenges - aging built environment, limited economic and ecological resources and digitisation - and the impetus for human wealth, industrial and technological development require an optimal use of technological, economic and ecological resources. A step towards an optimal resource forecasting, planning and use may be the integration of information, knowledge, technology performance and utility models and the utilisation of multi-, inter- and transdisciplinary decision analyses.
In built environment engineering - and since the first Mini-Symposium on Value of Information in Civil Engineering (MS-26) at the ICASP12 Conference in 2015, Vancouver, Canada - decision analyses and information value analyses have penetrated the scientific fields of e.g., Structural Health Monitoring, risk analyses and infrastructure management and have recently reached to resilience and sustainability science.
We encourage and welcome contributions in the perspective of actual challenges and potentials including contributions to the following topics:

10:00-12:00 Mháirtín Uí Chadhain, Level 2

MS 22: Recent advances in geotechnical risk and reliability

Parallel Session

Design and decision-making in geotechnical engineering are challenging for several reasons. First, geotechnical materials are nature-made with significant spatial variability, uncertain stratification, unknown lenses, thin layers, and so on. Second, site investigation data are usually sparse and incomplete, so there may be significant statistical uncertainties. Third, design soil parameters (such as undrained shear strength) are usually hard to measure directly, so various tests are adopted to indirectly estimate them through so-called transformation models. However, these models can be highly imprecise with large transformation uncertainties. Fourth, design equations are also imprecise with large model uncertainties. Fifth, each site is unique, so data from one site may not be directly applicable to another site. Geotechnical engineers constantly face the challenge of making decisions under these significant uncertainties.

This mini-symposium focuses on recent advances in geotechnical risk and reliability that address the aforementioned challenge. Abstracts within the following topics are welcomed:
1. Spatial variability
2. Reliability-based design
3. Risk, resilience, and sustainability
4. Data-driven methods
5. Probabilistic site investigation
6. Geological uncertainty
7. Propagation of uncertainty
8. Uncertainty related to climate change
9. Case histories

10:00-12:00 Beckett 1, Level 1

General Session

Parallel Session

10:00-12:00 Museum 1

MS 7: Risk, Reliability and Resilience of Complex Systems

Parallel Session

We are increasingly building engineered systems that, because of their inherent complexity, makes it extremely difficult to make well-informed decisions about strategies to improve their safety and resilience. This session focuses on risk, reliability and resilience-related problems where the system complexity is explicitly considered and conditions the problem approach.
MOTIVATION
The behaviour of complex systems, such as the system of systems and complex adaptive systems, is intrinsically difficult to model due to the dependencies and interactions between system parts. It is difficult to foresee how systems will evolve under changes in the environment and an adequate understanding enable a more accurate assessment of risk, reliability and resilience along with the identification of the optimal strategies to improve preparation, response and recovery to any changes.
OBJECTIVES:
This session will provide a platform for the researchers in the fields of risk, reliability and resilience of complex systems to present and discuss their recent advancements . Topics discussed in this session will include:
For more information about the conference, submission and important dates, please visit: https://icasp14.com/

10:00-12:00 Museum 2

MS 44: Recent developments on probabilistic modeling of systems

Parallel Session

This minisymposium focuses on recent advances on the representation, modeling, and analysis of systems. It will reflect on novel avenues in modeling and analysis of systems, as well as established state-of-the-art techniques and their applications. A particular focus is set on theoretical and practical challenges associated with the modeling of complex and increasingly inter-connected systems.
We encourage contributions that rely on the fusion of domain knowledge and (big) data-driven model updating, e.g., Bayesian approaches, model-based and/or physics-informed machine learning (ML). Another focus of the MS is on work towards the decomposition and interpretation of complex systems, e.g., explainable ML, uncertainty quantification, sensitivity analysis, and unsupervised learning. Additional topics relevant to the minisymposium include but are not limited to: big data analyses frameworks and techniques; probabilistic digital twins; decision-making under uncertainty; parameter, state, and system identification, and associated stochastic simulation techniques; as well as engineering applications in civil, structural, infrastructure, mechanical, aerospace, and offshore engineering.

10:00-12:00 Museum 3

MS 4: Quantitative assessment, performance prediction and design of interventions of existing concrete structures

Parallel Session

Assessment, repair and upgrading of existing concrete structures are becoming increasingly important and are associated to an increasing part of activities in the construction sector. Current state of the art lacks a consistent use of reliability-based approaches and the application of Bayesian updating techniques, although these enable to establish adequate through-life performance predictions, optimize inspections and interventions and fully exploit the combined knowledge available from information gathered through inspections and/or monitoring. Such evolution is however necessary to establish performant approaches for the assessment of existing concrete structures in a life-cycle framework.
Therefore, this mini-symposium focusses among others on the following topics:
- probabilistic modelling of degradation and damage progress
- probabilistic model-based performance prediction methods, enabling to incorporate time-dependent degradation effects, spatial variability and/or updated information based on investigations
- probabilistic model-independent performance prediction methods, enabling performance prediction in relation to asset management of a large building/infrastructure stock
- optimization techniques for inspection and monitoring strategies considering uncertainties
- optimization and decision making techniques for repair and strengthening under uncertainty
- case studies in which the above mentioned techniques are applied and/or validated

12:00-13:30 Arts Concourse

Lunch

Lunch

13:30-15:30 Thomas Davis, Level 2

MS 21: Community and Regional Resilience Modeling for Decision-Support

Parallel Session

Resilience is the ability to prepare for, adapt to, absorb, and recover rapidly from a disturbance such as a natural hazard. Comprehensive models of physical systems, their impacts on social and economic functions, and consideration of interdependencies can enable decision-makers to optimally plan for resilience using “what if” scenarios. Significant uncertainties exist in these models and their outcomes, often due to (1) simplifications or aggregation of models (or their interactions); (2) randomness in the hazard, system behavior or community characterization; and (3) approximations of resilience policies (e.g., building code or retrofit impacts), among other factors.

In this mini-symposium, papers/presentations are invited that focus on comprehensive community- and regional-level models, including interdisciplinary models, intended to inform resilience decision-making under uncertainty. These may include design code modifications, retrofits, community-level mitigation actions to adjust hazard intensity (e.g., levees), adaptive design, and mitigation and recovery policies across multiple hazards, including but not limited to climate change, wildfires, drought, earthquakes, hurricanes, floods, and tornadoes. Contributions that address modeling at the community and regional scales will be given preference, but specific institutional- and facility-scale resilience modeling studies are also invited.

13:30-15:30 JM Synge, Level 2

MS 20: Probabilistic modelling of natural hazards and associated risks

Parallel Session

Natural hazards can cause significant damages to built infrastructures and to human lives. Their assessment is therefore crucial for effectively dealing with these risks. This is often achieved in the framework of risk assessment where the frequency of the hazard is related to its intensity and to the incurred damage, most often using statistical-empirical approaches. Despite an increasing awareness of the importance of uncertainties associated to natural hazard risks, probabilistic methods are not systematically employed when assessing natural hazard risks. This can be problematic, especially in the case of low-frequency high-impact events.

This mini-symposium is dedicated to the application of probabilistic approaches for the assessment of natural hazard risks, including cascading and compound risks. Topics of interest include, but are not limited to: (1) the probabilistic modelling of hazards as well as vulnerability and exposure, (2) the application of uncertainty quantification methods in the field of natural hazard risks, including the use of physics-based numerical simulators and surrogate models, (3) the design of probabilistic hazard maps which allow for the visualization of uncertainties, and (4) the design of protective structures in hazard-prone areas based on probabilistic approaches.

13:30-15:30 Robert Emmet, Level 2

MS 29: Novel challenges in performance-based seismic design and seismic performance assessment of structures

Parallel Session

Over the past decades, risk-informed and performance-based methodologies for seismic design and seismic performance assessment for various types of structures have been developed incorporating uncertainties in seismic hazards. The aim of this mini symposium is to provide an opportunity for researchers in the fields of seismic risk and reliability analysis to present their current research challenges as well as future directions. Integrated approaches including framework development, computational & numerical procedures, and practical applications from related fields are welcome.

13:30-15:30 Jonathan Swift, Level 2

MS 40: Probabilistic Modelling of Bridge Traffic Loading

Parallel Session

The live loads to which bridges are subjected are one of the most variable actions in a bridge design or assessment. In spite of advances over recent decades, there still remains much conservatism throughout the models representing the phenomena, due to much that is unknown, or poorly modelled. This mini-symposium will bring together experts involved in the probabilistic modelling of vehicle and train actions. Included will be topics such as data-based modelling and simulation; dynamic vehicle-bridge interaction; traffic regimes, such as free-flow and jammed; heavy load platform loading; braking forces; centrifugal forces, and more. Particular attention will be given to fundamental probabilistic principles that should underpin such models, including bayesian methods and extreme-value theory approaches. By bringing together experts in these fields, progress in the area will be stimulated, coalesced, and hence accelerated; all to the betterment of sustainable assessment and design of bridges.

13:30-15:30 Mháirtín Uí Chadhain, Level 2

MS 23: Design Optimization of Structures under Uncertainty

Parallel Session

Design optimization of structures offers a rational decision-making tool for trading-off safety and cost. In particular, uncertainties are inevitable in engineering practice, generally in both structural parameters and external dynamic excitations. In this case, the dynamic reliability should also be taken into consideration either as objective function or as constraints. This brings about great challenges for design of optimization of structures, because both deterministic design optimization and dynamic reliability are usually of great computational efforts. The problem is even more challenging when structural topology optimization involving uncertainty is considered. To this end, the present mini-symposium is aimed at providing a platform of new advances in design optimization of structures with uncertainty. The papers with the following and other pertinent topics are welcome:

13:30-15:30 Beckett 1, Level 1

MS 17: Bayesian analysis of structural and geotechnical models

Parallel Session

Design and assessment of engineering systems is often based on numerical models of physical systems and involved processes. The parameters of the numerical models are determined by combining information from different sources such as direct measurements of the parameters or the system behavior, expert knowledge, categorical data and information from literature. In probability theory, the process of combining information to learn model parameters is formalized in the concept of Bayesian updating. Thereby, the prior probability distribution of the model parameters is updated with new data to a posterior distribution. The derived distribution can be further used for forward uncertainty propagation and reliability assessment of the system performance. This mini-symposium aims to attract papers that address either methodological developments or novel applications on Bayesian analysis of numerical models of structural and geotechnical systems. Individual relevant topics include: Markov chain Monte Carlo methods; sequential Montel Carlo methods; Taylor series approximations to the posterior; conjugate priors and Gibbs sampling; approximate Bayesian computation; structural identification; reliability updating; updating in the presence of spatial/time variability; updating of meta-models; applications that investigate the influence of prior considerations on the analysis results; definition of the likelihood function; representation of model errors; optimal experimental design.

13:30-15:30 Museum 1

MS 14: Timber engineering – Structural reliability, probabilistic modelling, environmental assessment

Parallel Session

Timber is a widely available natural grown building material, that is characterised by many advantages, such as the highly sustainability or the efficient strength to weight ratio. On the other hand, as a natural material, timber demonstrates a large variability of its material properties. Furthermore, the mechanical properties of timber are strongly dependent on type and orientation of stresses and are influenced significantly by moisture, fire or duration of load.
In order to improve the quality of timber, engineered wood products have been developed. Compared to solid wooden members, engineered wood products have many advantages, such as a lower variability of the material properties, or the larger range of available component dimensions to choose from. Because of that, timber has been established as a competitive building product within the last decades.
However, there is still a large potential for improving the performance of structural timber and engineered wood products. In the present mini-symposium the latest findings will be demonstrated and discussed. The following aspects among others are particularly addressed:
Timber grading, engineered wood products, LCA, sustainable use of the material, seismic response, climate and load duration aspects, fire exposure, timber connections, robustness, durability

13:30-15:30 Museum 2

MS 13: Reliability assessment in computational structural dynamics: Advancements in theory and applications

Parallel Session

Engineering structures are sometimes exposed to disastrous dynamic loading, such as strong wind and seismic motions. Structural failure due to these loads leads to significant economic loss and societal distress. Prediction of reliability during the service time is therefore essential in the design of new or integrity assessment of existing structures. Developments in computational mechanics provide tools to predict the structural performance by means of simulation models. However, the parameters of these models, such as loading, material and geometric properties, deterioration processes and boundary conditions, can be seldom determined uniquely as they are affected by uncertainty and randomness. Model-based dynamic reliability assessment involves propagation of the input uncertainties through the model and exploration of the tails of the system response.
This mini-symposium invites contributions dealing with model-based reliability assessment procedures for structural dynamic systems. A non-exhaustive list of topics includes methods for reliability analysis, linear and nonlinear structural behaviour, efficient approximation methods, Monte Carlo sampling approaches, surrogate models and machine learning approaches, methods for robust reliability updating using data, dynamic reliability sensitivity analysis and reliability-based optimization. Contributions dealing with novel applications and experimental investigation of theories are also welcome.

13:30-15:30 Museum 3

MS 9: Performance assessment of existing structures – concepts and methods

Parallel Session

The approach for the performance assessment of existing structures is in many aspects different from that considered at the design stage. The application of design-orientated methods to the assessment of existing structures often leads to a high degree of conservatism, which may have severe economic, environment and socio-political consequences when it results in satisfactory structures being condemned as unsafe, thereby leading to an unnecessary investment of resources in replacement or retrofitting, with its associated dismantling. Also, the potentially available information about geometry, material properties, loading and environmental conditions is not the same for new and existing structures and this implies to take into account different levels of uncertainty.
In this mini-symposium, focus is given to recent developments in relation to:
This mini-symposium will also report on advances and new developments within the IABSE, JCSS, fib and Eurocodes technical committees working on performance assessment of existing structures.

15:30-16:00 Arts Concourse

Tea/Coffee Break

Tea/Coffee Break

16:00-16:45 Ed Burke, Level 1

Plenary

Keynote Session

Chairs: Prof. Alan O'Connor & Prof. Vikram Pakrashi

16:00-16:45 Robert Emmet, Level 2

Relay of Keynote Plenary

Keynote Session

Tuesday, 11 July, 2023

08:00-08:45 Arts Concourse

Registration

Registration

08:45-09:30 Ed Burke, Level 1

Plenary

Keynote Session

Chairs: Prof. Alan O'Connor & Prof. Vikram Pakrashi

08:45-09:30 Robert Emmet, Level 2

Relay of Keynote Plenary

Keynote Session

09:30-10:00 Arts Concourse

Tea/Coffee Break

Tea/Coffee Break

10:00-12:00 Thomas Davis, Level 2

MS 19: Surrogate and Reduced Order Models

Parallel Session

Computer simulation has become central in all fields of engineering and applied sciences in the last decades. High-fidelity simulators (e.g. finite element models) are commonly used all along the design process of complex systems. However, using these models directly to optimize designs, to assess the impact of uncertainties on reliability and robustness, to pursue model calibration from experimental data or to carry out global sensitivity analysis is not feasible due to computational costs. For this reason, surrogate modelling has gained major interest in the recent years. The aim of this mini-symposium is to highlight new research trends in the field of surrogate modelling. Contributions on established techniques such as (sparse) polynomial chaos expansions, Kriging, support vector regression, sparse grid interpolation, etc. are welcome, but also data-driven approaches stemming from machine learning such as (deep) neural networks, random forests, etc. Topics of interest include, but are not limited to active learning, ensemble modelling, dimensionality reduction. Significant applications in new or emerging fields are also welcome.
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10:00-12:00 JM Synge, Level 2

MS 6: Optimal decision making under uncertainty

Parallel Session

Results from engineering assessments ultimately serve as decision support. Hence it is often relevant to set the assessments in the context of a formal decision analysis, to ensure an optimal choice of methods and interpretation of results. In addition, the advent of increasingly automated and autonomous systems that perform their own decision making requires new approaches and methods for quantifying and validating performance, safety, and reliability.
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10:00-12:00 Robert Emmet, Level 2

MS 28: Structural Health Monitoring and Uncertainties in Modeling and Inspection

Parallel Session

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10:00-12:00 Jonathan Swift, Level 2

MS 25: Information Value and Decision Analyses

Parallel Session

Actual scientific, societal and industrial challenges - aging built environment, limited economic and ecological resources and digitisation - and the impetus for human wealth, industrial and technological development require an optimal use of technological, economic and ecological resources. A step towards an optimal resource forecasting, planning and use may be the integration of information, knowledge, technology performance and utility models and the utilisation of multi-, inter- and transdisciplinary decision analyses.
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We encourage and welcome contributions in the perspective of actual challenges and potentials including contributions to the following topics:

10:00-12:00 Mháirtín Uí Chadhain, Level 2

MS 22: Recent advances in geotechnical risk and reliability

Parallel Session

Design and decision-making in geotechnical engineering are challenging for several reasons. First, geotechnical materials are nature-made with significant spatial variability, uncertain stratification, unknown lenses, thin layers, and so on. Second, site investigation data are usually sparse and incomplete, so there may be significant statistical uncertainties. Third, design soil parameters (such as undrained shear strength) are usually hard to measure directly, so various tests are adopted to indirectly estimate them through so-called transformation models. However, these models can be highly imprecise with large transformation uncertainties. Fourth, design equations are also imprecise with large model uncertainties. Fifth, each site is unique, so data from one site may not be directly applicable to another site. Geotechnical engineers constantly face the challenge of making decisions under these significant uncertainties.

This mini-symposium focuses on recent advances in geotechnical risk and reliability that address the aforementioned challenge. Abstracts within the following topics are welcomed:
1. Spatial variability
2. Reliability-based design
3. Risk, resilience, and sustainability
4. Data-driven methods
5. Probabilistic site investigation
6. Geological uncertainty
7. Propagation of uncertainty
8. Uncertainty related to climate change
9. Case histories

10:00-12:00 Beckett 1, Level 1

General Session

Parallel Session

10:00-12:00 Museum 1

MS 7: Risk, Reliability and Resilience of Complex Systems

Parallel Session

We are increasingly building engineered systems that, because of their inherent complexity, makes it extremely difficult to make well-informed decisions about strategies to improve their safety and resilience. This session focuses on risk, reliability and resilience-related problems where the system complexity is explicitly considered and conditions the problem approach.
MOTIVATION
The behaviour of complex systems, such as the system of systems and complex adaptive systems, is intrinsically difficult to model due to the dependencies and interactions between system parts. It is difficult to foresee how systems will evolve under changes in the environment and an adequate understanding enable a more accurate assessment of risk, reliability and resilience along with the identification of the optimal strategies to improve preparation, response and recovery to any changes.
OBJECTIVES:
This session will provide a platform for the researchers in the fields of risk, reliability and resilience of complex systems to present and discuss their recent advancements . Topics discussed in this session will include:
For more information about the conference, submission and important dates, please visit: https://icasp14.com/

10:00-12:00 Museum 2

MS 44: Recent developments on probabilistic modeling of systems

Parallel Session

This minisymposium focuses on recent advances on the representation, modeling, and analysis of systems. It will reflect on novel avenues in modeling and analysis of systems, as well as established state-of-the-art techniques and their applications. A particular focus is set on theoretical and practical challenges associated with the modeling of complex and increasingly inter-connected systems.
We encourage contributions that rely on the fusion of domain knowledge and (big) data-driven model updating, e.g., Bayesian approaches, model-based and/or physics-informed machine learning (ML). Another focus of the MS is on work towards the decomposition and interpretation of complex systems, e.g., explainable ML, uncertainty quantification, sensitivity analysis, and unsupervised learning. Additional topics relevant to the minisymposium include but are not limited to: big data analyses frameworks and techniques; probabilistic digital twins; decision-making under uncertainty; parameter, state, and system identification, and associated stochastic simulation techniques; as well as engineering applications in civil, structural, infrastructure, mechanical, aerospace, and offshore engineering.

10:00-12:00 Museum 3

MS 38: Reliability, Risk and Resilience of Civil Engineering Systems under Multiple Hazards

Parallel Session

An earthquake could cause multiple disasters, including damage to structures due to ground motions, liquefaction and/or the washout of structures due to subsequent tsunamis. In addition, seismic capacity would deteriorate due to the material corrosion and scour caused by the flood. Comparing the reliability, risk and/or resilience among structures under independent and interacting hazards is useful for identifying significant threat scenarios.
Different types of hazards such as independent hazards, correlated hazards, concurrent hazards and cascading hazards have been investigated in the literature. In addition, climate change leads to the varying frequency and intensity of various natural hazards detrimental to the safety, serviceability, and functionality of civil infrastructure systems. These detrimental effects not only increase the risks of structures under individual extreme events, but also exhibit correlated characteristics that can amplify structural vulnerabilities under both climate-related and climate-unrelated hazards.
This MS will discuss the multi-hazard effects on reliability, risk and resilience of infrastructure systems under multiple hazards. Examples of multi-hazards that are expected to be discussed in this MS, although not limited to the following topics, are: seismic motion and tsunami; seismic motion and scour; seismic motion and corrosion; climate change and corrosion; and climate change and scou

12:00-13:30 Arts Concourse

Lunch

Lunch

13:30-15:30 Thomas Davis, Level 2

MS 21: Community and Regional Resilience Modeling for Decision-Support

Parallel Session

Resilience is the ability to prepare for, adapt to, absorb, and recover rapidly from a disturbance such as a natural hazard. Comprehensive models of physical systems, their impacts on social and economic functions, and consideration of interdependencies can enable decision-makers to optimally plan for resilience using "what if" scenarios. Significant uncertainties exist in these models and their outcomes, often due to (1) simplifications or aggregation of models (or their interactions); (2) randomness in the hazard, system behavior or community characterization; and (3) approximations of resilience policies (e.g., building code or retrofit impacts), among other factors.

In this mini-symposium, papers/presentations are invited that focus on comprehensive community- and regional-level models, including interdisciplinary models, intended to inform resilience decision-making under uncertainty. These may include design code modifications, retrofits, community-level mitigation actions to adjust hazard intensity (e.g., levees), adaptive design, and mitigation and recovery policies across multiple hazards, including but not limited to climate change, wildfires, drought, earthquakes, hurricanes, floods, and tornadoes. Contributions that address modeling at the community and regional scales will be given preference, but specific institutional- and facility-scale resilience modeling studies are also invited.

13:30-15:30 JM Synge, Level 2

MS 20: Probabilistic modelling of natural hazards and associated risks

Parallel Session

Natural hazards can cause significant damages to built infrastructures and to human lives. Their assessment is therefore crucial for effectively dealing with these risks. This is often achieved in the framework of risk assessment where the frequency of the hazard is related to its intensity and to the incurred damage, most often using statistical-empirical approaches. Despite an increasing awareness of the importance of uncertainties associated to natural hazard risks, probabilistic methods are not systematically employed when assessing natural hazard risks. This can be problematic, especially in the case of low-frequency high-impact events.

This mini-symposium is dedicated to the application of probabilistic approaches for the assessment of natural hazard risks, including cascading and compound risks. Topics of interest include, but are not limited to: (1) the probabilistic modelling of hazards as well as vulnerability and exposure, (2) the application of uncertainty quantification methods in the field of natural hazard risks, including the use of physics-based numerical simulators and surrogate models, (3) the design of probabilistic hazard maps which allow for the visualization of uncertainties, and (4) the design of protective structures in hazard-prone areas based on probabilistic approaches.

13:30-15:30 Robert Emmet, Level 2

MS 29: Novel challenges in performance-based seismic design and seismic performance assessment of structures

Parallel Session

Over the past decades, risk-informed and performance-based methodologies for seismic design and seismic performance assessment for various types of structures have been developed incorporating uncertainties in seismic hazards. The aim of this mini symposium is to provide an opportunity for researchers in the fields of seismic risk and reliability analysis to present their current research challenges as well as future directions. Integrated approaches including framework development, computational & numerical procedures, and practical applications from related fields are welcome.

13:30-15:30 Jonathan Swift, Level 2

MS 40: Probabilistic Modelling of Bridge Traffic Loading

Parallel Session

The live loads to which bridges are subjected are one of the most variable actions in a bridge design or assessment. In spite of advances over recent decades, there still remains much conservatism throughout the models representing the phenomena, due to much that is unknown, or poorly modelled. This mini-symposium will bring together experts involved in the probabilistic modelling of vehicle and train actions. Included will be topics such as data-based modelling and simulation; dynamic vehicle-bridge interaction; traffic regimes, such as free-flow and jammed; heavy load platform loading; braking forces; centrifugal forces, and more. Particular attention will be given to fundamental probabilistic principles that should underpin such models, including bayesian methods and extreme-value theory approaches. By bringing together experts in these fields, progress in the area will be stimulated, coalesced, and hence accelerated; all to the betterment of sustainable assessment and design of bridges.

13:30-15:30 Mháirtín Uí Chadhain, Level 2

MS 23: Design Optimization of Structures under Uncertainty

Parallel Session

Design optimization of structures offers a rational decision-making tool for trading-off safety and cost. In particular, uncertainties are inevitable in engineering practice, generally in both structural parameters and external dynamic excitations. In this case, the dynamic reliability should also be taken into consideration either as objective function or as constraints. This brings about great challenges for design of optimization of structures, because both deterministic design optimization and dynamic reliability are usually of great computational efforts. The problem is even more challenging when structural topology optimization involving uncertainty is considered. To this end, the present mini-symposium is aimed at providing a platform of new advances in design optimization of structures with uncertainty. The papers with the following and other pertinent topics are welcome:

13:30-15:30 Beckett 1, Level 1

MS 17: Bayesian analysis of structural and geotechnical models

Parallel Session

Design and assessment of engineering systems is often based on numerical models of physical systems and involved processes. The parameters of the numerical models are determined by combining information from different sources such as direct measurements of the parameters or the system behavior, expert knowledge, categorical data and information from literature. In probability theory, the process of combining information to learn model parameters is formalized in the concept of Bayesian updating. Thereby, the prior probability distribution of the model parameters is updated with new data to a posterior distribution. The derived distribution can be further used for forward uncertainty propagation and reliability assessment of the system performance. This mini-symposium aims to attract papers that address either methodological developments or novel applications on Bayesian analysis of numerical models of structural and geotechnical systems. Individual relevant topics include: Markov chain Monte Carlo methods; sequential Montel Carlo methods; Taylor series approximations to the posterior; conjugate priors and Gibbs sampling; approximate Bayesian computation; structural identification; reliability updating; updating in the presence of spatial/time variability; updating of meta-models; applications that investigate the influence of prior considerations on the analysis results; definition of the likelihood function; representation of model errors; optimal experimental design.

13:30-15:30 Museum 1

MS 14: Timber engineering – Structural reliability, probabilistic modelling, environmental assessment

Parallel Session

Timber is a widely available natural grown building material, that is characterised by many advantages, such as the highly sustainability or the efficient strength to weight ratio. On the other hand, as a natural material, timber demonstrates a large variability of its material properties. Furthermore, the mechanical properties of timber are strongly dependent on type and orientation of stresses and are influenced significantly by moisture, fire or duration of load.
In order to improve the quality of timber, engineered wood products have been developed. Compared to solid wooden members, engineered wood products have many advantages, such as a lower variability of the material properties, or the larger range of available component dimensions to choose from. Because of that, timber has been established as a competitive building product within the last decades.
However, there is still a large potential for improving the performance of structural timber and engineered wood products. In the present mini-symposium the latest findings will be demonstrated and discussed. The following aspects among others are particularly addressed:
Timber grading, engineered wood products, LCA, sustainable use of the material, seismic response, climate and load duration aspects, fire exposure, timber connections, robustness, durability

13:30-15:30 Museum 2

MS 13: Reliability assessment in computational structural dynamics: Advancements in theory and applications

Parallel Session

Engineering structures are sometimes exposed to disastrous dynamic loading, such as strong wind and seismic motions. Structural failure due to these loads leads to significant economic loss and societal distress. Prediction of reliability during the service time is therefore essential in the design of new or integrity assessment of existing structures. Developments in computational mechanics provide tools to predict the structural performance by means of simulation models. However, the parameters of these models, such as loading, material and geometric properties, deterioration processes and boundary conditions, can be seldom determined uniquely as they are affected by uncertainty and randomness. Model-based dynamic reliability assessment involves propagation of the input uncertainties through the model and exploration of the tails of the system response.
This mini-symposium invites contributions dealing with model-based reliability assessment procedures for structural dynamic systems. A non-exhaustive list of topics includes methods for reliability analysis, linear and nonlinear structural behaviour, efficient approximation methods, Monte Carlo sampling approaches, surrogate models and machine learning approaches, methods for robust reliability updating using data, dynamic reliability sensitivity analysis and reliability-based optimization. Contributions dealing with novel applications and experimental investigation of theories are also welcome.

13:30-15:30 Museum 3

MS 18: Risk-Targeted Design Loads for Buildings and Infrastructure

Parallel Session

For designing buildings and infrastructure against earthquakes and other natural hazards, construction-code standards such as ASCE 7, Minimum Design Loads for Buildings and Other Structures have historically relied on uniform-hazard design loads that correspond to a specified return period of the hazard-induced load of interest (e.g., seismic, snow, flood, tornado, wind, ice, rain, or tsunami). In the case of seismic, design loads in the United States have been modified from uniform-hazard to risk-targeted, with the latter targeting a return period of structural failure (e.g., building collapse in ASCE 7-22).
The purpose of this mini-symposium is to discuss recent developments in various aspects of risk-targeted design loads, including:

15:30-16:00 Arts Concourse

Tea/Coffee Break

Tea/Coffee Break

16:00-16:45 Ed Burke, Level 1

Plenary

Keynote Session

Chairs: Prof. Alan O'Connor & Prof. Vikram Pakrashi

16:00-16:45 Robert Emmet, Level 2

Relay of Keynote Plenary

Keynote Session

19:00-22:00 Mansion House

Conference Gala Dinner

Evening Event

Ticket required. Please email the conference secretariat if you would like to add this to your registration.

Wednesday, 12 July, 2023

08:00-08:45 Arts Concourse

Registration

Registration

08:45-09:30 Ed Burke, Level 1

Plenary

Keynote Session

Chairs: Prof. Alan O'Connor & Prof. Vikram Pakrashi

08:45-09:30 Robert Emmet, Level 2

Relay of Keynote Plenary

Keynote Session

09:30-10:00 Arts Concourse

Tea/Coffee Break

Tea/Coffee Break

10:00-12:00 Thomas Davis, Level 2

MS 19: Surrogate and Reduced Order Models

Parallel Session

Computer simulation has become central in all fields of engineering and applied sciences in the last decades. High-fidelity simulators (e.g. finite element models) are commonly used all along the design process of complex systems. However, using these models directly to optimize designs, to assess the impact of uncertainties on reliability and robustness, to pursue model calibration from experimental data or to carry out global sensitivity analysis is not feasible due to computational costs. For this reason, surrogate modelling has gained major interest in the recent years. The aim of this mini-symposium is to highlight new research trends in the field of surrogate modelling. Contributions on established techniques such as (sparse) polynomial chaos expansions, Kriging, support vector regression, sparse grid interpolation, etc. are welcome, but also data-driven approaches stemming from machine learning such as (deep) neural networks, random forests, etc. Topics of interest include, but are not limited to active learning, ensemble modelling, dimensionality reduction. Significant applications in new or emerging fields are also welcome.
Uncertainty quantification (UQ) of engineering structures remains a computationally expensive task, although significant achievements have been made in computing technology. UQ in forward and inverse problems requires solving a discretized version of the governing differential equation multiple times. This discretized differential equation often involves significantly large degrees of freedom, making UQ a computationally prohibitive task. This mini-symposium will focus on computational challenges and the recent development of numerical methods for UQ using reduced order modeling. The scope of the mini-symposium involves topics on uncertainty quantification, inverse problem, data-driven modeling using machine learning, reliability analysis, surrogate modeling, and reduced-order modeling. Applications of the developed methods to structural and fluid dynamical systems are also encouraged.

10:00-12:00 JM Synge, Level 2

MS 6: Optimal decision making under uncertainty

Parallel Session

Results from engineering assessments ultimately serve as decision support. Hence it is often relevant to set the assessments in the context of a formal decision analysis, to ensure an optimal choice of methods and interpretation of results. In addition, the advent of increasingly automated and autonomous systems that perform their own decision making requires new approaches and methods for quantifying and validating performance, safety, and reliability.
This mini-symposium aims at gathering researchers interested in developing and applying methods for optimal decision making under uncertainty for engineering systems. It focuses on optimization involving stochastic environments, objectives and constraints, and the integration of formal decision analysis with stochastic models, simulators, data analytics, and artificial intelligence methodologies towards long-term planning in complex settings. These include sequential decision processes but also decisions involving multiple stakeholders, among others. Selection of metrics for stochastic analysis based on decision-theoretic considerations are also of interest, such as the choice of appropriate objective functions and decision-theoretic sensitivity measures.

10:00-12:00 Robert Emmet, Level 2

MS 28: Structural Health Monitoring and Uncertainties in Modeling and Inspection

Parallel Session

Visual structural inspection remains the most commonly used method of investigating structural health, despite biased inspection results. Structural health monitoring (SHM), on the other hand, has been studied with the expectation that it will provide useful information for quantitative assessment of structural health and updating of structural models. However, due to the lack of satisfactory results in real-world conditions caused by uncertainties in mathematical modelling and sensing in SHM, it has not been widely accepted by the authorities.
The scope of this mini-symposium is to bring together experts, researchers, academics and practicing engineers concerned with the various aspects of SHM and uncertainties in modeling and inspection. Contributions addressing developments in the theoretical, and computational approaches as well as practical applications are invited

10:00-12:00 Jonathan Swift, Level 2

MS 41: Calibration of Structural Design Codes

Parallel Session

Given the tremendous challenges our society is facing, i.e. in regard to the expected changes in our environment due to climate change and the increasing pressure on our natural resources, the international research community is in demand to find solutions that provide the foundation for our sustainable development. Here, the built environment is of obvious importance as it not only facilitates societal activity but also has a major share on the worldwide turnover of economic and environmental resources. To date the built environment is developed and maintained by broadly following structural design standards, which did evolve continuously over time and contain safety concepts that support daily structural engineering decision making based on simple calculus. The major objective that has been followed in their development, was the provision of sufficient safety, and the observed relative low failure rates do proof success in this regard.

10:00-12:00 Mháirtín Uí Chadhain, Level 2

MS 15: Applications of Statistics and Probability in Renewable Energy Systems

Parallel Session

Offshore wind turbines are the largest rotating structures on Earth. Modern horizontal axis wind turbines commonly have tower heights exceeding 120m and blade lengths greater than 80m. These large, flexible structures are installed in harsh environments with significant stochastic loading from turbulent wind and waves. Structural reliability analysis has played a major role in developing offshore wind turbine technology and will be key in progressing the field forward with a constant need for larger structures in harsher environments. Reliability-based design is the guiding tool for all structural design and will therefore be imperative to ensure profitable and safe operation of these machines for their design lives of at least 20 years.
Offshore wind and wave energy systems have proved to be a key technology behind driving the promotion of renewable energy and the related achievement of renewable energy targets throughout the world. There remain significant challenges around a) uncertainties in the structural responses of renewable energy devices; b) uncertainties and variabilities of availability of renewable energy resources and c) uncertainties and variations around efficient inspection, testing, maintenance and management of these infrastructure systems. Statistical and probabilistic methods are closely related to addressing all these challenges. This special-session aims at bringing a range of researchers with disparate skills together to emphasize the importance of statistics and probability in this extremely promising and fast burgeoning field. Contributions may be theoretical or experimental and can relate to offshore wind, wave or combined solutions. The contributions include, but are not limited to novel designs, testing of scaled or full scale systems, modelling and characterization of wind and/or wave energy availability and variation, estimation of exposure conditions, extreme value statistics, system identification and monitoring, accurate numerical analysis, estimates of effects of climate change, instrumentation, operations and maintenance, reliability analysis, array optimisation and utilisation of dynamical responses for system identification or monitoring.

10:00-12:00 Beckett 1, Level 1

MS 37: Reliability Based Assessment of Structures

Parallel Session

Infrastructure owners/managers are increasingly faced with structures which fail to document sufficient load carrying capacity when assessed to codes to which they were not, in some cases, designed. The result often leads to the need for strengthening or replacement actions, which represent an unsatisfactory outcome from both economic, and sustainability perspectives. This has lead to a move to increase the adoption of reliability based methods as proposed for example in the draft Eurocode for Assessment and Retrofit of Existing Structures and in the Danish Roads Directorates Guideline for Reliability Based Classification of the Load Carrying Capacity of Existing Bridges.
This mini-symposium aims to bring together researchers and practitioners in order to present, discuss and exchange information and ideas on reliability based assessment of structures, with particular emphasis on (i) consideration of uncertainty and (ii) including considerations of sustainability in the assessment.
It is expected that the mini-symposium will provide an overview of the state-of-the-art and will help to identify areas for further developments and applications of reliability based assessment of structures.

10:00-12:00 Museum 1

MS 27: Data-driven and physical-informed methods for structural reliability assessment and design under deep uncertainties

Parallel Session

Coping with uncertainty becomes a necessity in almost all practical situations in structural design. In fact, uncertainty appears on the characterization of loadings, material properties, deterioration processes, etc., and may severely affect structural behaviour. Sources of uncertainty may be classified as aleatoric (that is, randomness) or epistemic, due to lack of knowledge or imprecise information. This problem has generated significant developments on generalized approaches for uncertainty quantification with the key question of how to model these deep uncertainties, encompassing randomness and imprecision simultaneously. In many practical cases only ranges or bounds are available for some parameters so that set-theoretical descriptors provide an appropriate model. In combination with probabilistic information, this leads to imprecise probabilities. Nonetheless, practical applications of imprecise probability approaches remain challenging, as they entail considerable additional efforts when compared to their deterministic, semi-probabilistic or probabilistic counterparts. Therefore, this mini-symposium aims at bundling the most recent developments in imprecise probabilities and their application to structural design, including (but not limited to): different variants of imprecise probability analysis, such as interval probabilities, p-box approach, evidence theory, fuzzy probabilities and so forth; numerical approaches for forward and inverse uncertainty quantification; determination of probability bounds, data-driven and grey-box techniques, etc.

10:00-12:00 Museum 2

MS 5: Civil Infrastructure in a Changing Climate: from Nonstationary Risk Assessment to Developing Adaptation Strategies

Parallel Session

A warming trend has been reported by the UN Intergovernmental Panel on Climate Change since 1950s with the increasing greenhouse gas concentration, leading to sea-level rise, hotter drier summers, warmer wetter winters, more floods, increasing wind speeds, etc. Such change in climate alters the environment that built infrastructure is exposed to and poses a major threat to their safety. Various impacts of climate change on the risk to built infrastructure have been investigated by researchers in structural and building engineering.
This Mini-Symposium will bring together researchers to share the latest advances in climate change research for civil infrastructure and building adaptation. Topics of interest include, but are not limited to: (1) modeling methods for nonstationary risk of the failure of infrastructure assets and systems, including the impact on the extreme weather or climate events, structural loads and structural vulnerability, (2) assessment of the climate change impact on the risk and performance of civil infrastructure in different regions and at different temporal and spatial scales, (3) development of civil infrastructure adaptation strategies and the implementation supports, and (4) issues for stakeholders and decision-making: consideration of risk perception, acceptability of adaptation strategies, and deep uncertainty, and development of decision frameworks.

10:00-12:00 Museum 3

MS 24: Vibration Analysis and Mitigation of Structures under Uncertainties

Parallel Session

Vibration analysis and mitigation of engineering structures and infrastructure systems subjected to hazardous actions such as strong earthquakes and high winds have been of main concern to the civil engineering community. However, this task still remains challenging since many uncertainties associated with the occurring time, location and intensity of hazardous actions, as well as with the structural materials and systems. Therefore, the vibration analysis and mitigation of engineering structures and infrastructure systems under uncertainties are important to ensure their safety. In recent years, many advanced random vibration methods and novel vibration mitigation techniques have been proposed to assess and improve the performance of complex engineering structures and infrastructure systems. In view of this situation, the aim of this mini-symposium is addressing the advances on theories and methods of vibration analysis and mitigation of structures considering the uncertainties associated with external excitations or structural systems. The scope of the mini-symposium is broad, contributions related to the following topics and other pertinent topics are welcome:

12:00-13:30 Arts Concourse

Lunch

Lunch

13:30-15:30 Thomas Davis, Level 2

MS 21: Community and Regional Resilience Modeling for Decision-Support

Parallel Session

Resilience is the ability to prepare for, adapt to, absorb, and recover rapidly from a disturbance such as a natural hazard. Comprehensive models of physical systems, their impacts on social and economic functions, and consideration of interdependencies can enable decision-makers to optimally plan for resilience using “what if” scenarios. Significant uncertainties exist in these models and their outcomes, often due to (1) simplifications or aggregation of models (or their interactions); (2) randomness in the hazard, system behavior or community characterization; and (3) approximations of resilience policies (e.g., building code or retrofit impacts), among other factors.

In this mini-symposium, papers/presentations are invited that focus on comprehensive community- and regional-level models, including interdisciplinary models, intended to inform resilience decision-making under uncertainty. These may include design code modifications, retrofits, community-level mitigation actions to adjust hazard intensity (e.g., levees), adaptive design, and mitigation and recovery policies across multiple hazards, including but not limited to climate change, wildfires, drought, earthquakes, hurricanes, floods, and tornadoes. Contributions that address modeling at the community and regional scales will be given preference, but specific institutional- and facility-scale resilience modeling studies are also invited.

13:30-15:30 JM Synge, Level 2

MS 20: Probabilistic modelling of natural hazards and associated risks

Parallel Session

Natural hazards can cause significant damages to built infrastructures and to human lives. Their assessment is therefore crucial for effectively dealing with these risks. This is often achieved in the framework of risk assessment where the frequency of the hazard is related to its intensity and to the incurred damage, most often using statistical-empirical approaches. Despite an increasing awareness of the importance of uncertainties associated to natural hazard risks, probabilistic methods are not systematically employed when assessing natural hazard risks. This can be problematic, especially in the case of low-frequency high-impact events.

This mini-symposium is dedicated to the application of probabilistic approaches for the assessment of natural hazard risks, including cascading and compound risks. Topics of interest include, but are not limited to: (1) the probabilistic modelling of hazards as well as vulnerability and exposure, (2) the application of uncertainty quantification methods in the field of natural hazard risks, including the use of physics-based numerical simulators and surrogate models, (3) the design of probabilistic hazard maps which allow for the visualization of uncertainties, and (4) the design of protective structures in hazard-prone areas based on probabilistic approaches.

13:30-15:30 Robert Emmet, Level 2

MS 29: Novel challenges in performance-based seismic design and seismic performance assessment of structures

Parallel Session

Over the past decades, risk-informed and performance-based methodologies for seismic design and seismic performance assessment for various types of structures have been developed incorporating uncertainties in seismic hazards. The aim of this mini symposium is to provide an opportunity for researchers in the fields of seismic risk and reliability analysis to present their current research challenges as well as future directions. Integrated approaches including framework development, computational & numerical procedures, and practical applications from related fields are welcome.

13:30-15:30 Jonathan Swift, Level 2

MS 11: Multi-hazard risk modelling: beyond conventional approaches

Parallel Session

The last few decades have seen an increase in the development and application of risk modelling frameworks to quantify the impact of natural and human-made hazards. However, state-of-practice models continue to be limited since they typically: capture the effects of a single hazard; represent risk exclusively in terms of economic losses; and are only suitable for uncoupled assets (neglecting networked infrastructure). Furthermore, the application of these models beyond traditional risk management users, such as insurers, remains largely underexplored.
This symposium will explore opportunities for addressing these shortcomings, paving the way towards a shift in how we approach risk modelling. We welcome innovative contributions including but not limited to: (a) loss-based design of assets for single or multiple hazards; (b) user-centred approaches for system-level disaster risk reduction decisions; (c) methods for modelling functional recovery of the built environment; (d) risk metrics that acknowledge the disproportionate impacts socially-vulnerable communities hold; (e) quantification of dynamic risk to account for the time-dependent uncertainty inherent in hazard, exposure, and vulnerability; (f) and multi-risk approaches that capture realistic multi-hazard interactions within hazard, vulnerability, and exposure. A review paper featuring selected presentations from this symposium is planned in the International Journal of Disaster Risk Reduction.

13:30-15:30 Mháirtín Uí Chadhain, Level 2

MS 8: Recent Advances in Stochastic Engineering Dynamics

Parallel Session

Ever-increasing computational capabilities, novel signal processing techniques, and advanced experimental setups have contributed to a highly complex modeling of engineering systems and related excitations. Examples include diverse nonlinearities, hysteresis, joint time-frequency representations, and fractional derivative models. In many cases even the deterministic solution of the corresponding governing equations is an open issue and an active research topic. Clearly, solving the stochastic counterparts of these equations becomes even more challenging, especially for high-dimensional systems.
The objective of this MS is to present recent advances and emerging cross-disciplinary approaches in the broad field of computational methods for stochastic engineering dynamics. Further, this MS intends to provide a forum for a fruitful exchange of ideas and interaction among diverse technical and scientific disciplines. Specific contributions related both to fundamental research and to engineering applications of stochastic dynamics and signal processing methodologies are welcome. A non-exhaustive list includes joint time-frequency analysis techniques, sparse representations concepts and tools, stochastic/fractional calculus modeling and applications, nonlinear stochastic dynamics, stochastic model/dimension reduction methods, Monte Carlo simulation schemes, and risk/reliability assessment applications.

13:30-15:30 Beckett 1, Level 1

General Session

Parallel Session

13:30-15:30 Museum 1

MS 1: Data-Driven Risk Assessment of Structures and Infrastructure against Natural Hazards

Parallel Session

Structural and infrastructure facilities have been increasingly affected by natural hazards due to the ever-changing built and climate environment where aleatory and epistemic uncertainties are involved in both the structures and hazard loads. In that respect, developing reliable risk-informed approaches for structural loss quantification plays a central role in high-confidence decision-making. Existing approaches can be generally classified into physics-based and data-driven ones. The former is often characterized by solid physical bases whereas the latter has been found efficient and robust, especially for regional-level risk assessment of communities that comprise various structures and infrastructure against multiple hazards.
To move forward the frontier of data-driven risk assessment of structures against natural hazards, this mini-symposia provides an opportunity for researchers and engineers to present their recent achievement and insight/thoughts on future directions. Fundamental research and practical applications are both welcome. Pertinent topics include, but are not limited to:

13:30-15:30 Museum 2

MS 39: Climate-resilient infrastructure networks: modeling and evaluating resilience enhancing interventions

Parallel Session

Infrastructure networks are susceptible to hazard events that affect their serviceability leading to direct and indirect consequences for the society. This necessitates network managers to regularly assess the resilience of their system, and make decisions on if/what interventions can be implemented to meet resilience objectives. This need is becoming ever more prevalent in the case of climatic hazards, e.g., heavy rainfall and flooding, as their frequency and severity have been increasing due to climate change. Evaluating the effectiveness of interventions in enhancing the resilience of networks under climatic hazards, however, is a substantially challenging task. This is largely due to the 1) complex and uncertain spatiotemporal nature of climatic hazards, 2) complexities and uncertainties in predicting their impact on infrastructure networks, considering the interdependencies, and 3) modeling interventions considering their interaction with hazards and infrastructure networks and hence, evaluating their impact on enhancing resilience.
This session provides a platform for the involved researchers in the fields of risk and resilience of infrastructure networks to present their recent advancements and exchange their ideas. The session will be mainly focused on modeling and evaluating the effect of interventions on enhancing the resilience of infrastructure networks against climatic hazard events.

13:30-15:30 Museum 3

MS 30: Probabilistic Design and Reliability of Offshore Wind Turbines

Parallel Session

Offshore wind energy is currently playing an important role in reducing emission of greenhouse gasses. To make offshore wind energy more cost-comparative, the dimensions of the structure are increasing rapidly so that the power of individual wind turbines can be greatly increased. However, this poses great challenges for the structural safety design. On the one hand, the complex coupled large system is usually deployed in harsh offshore conditions, where the structures are subjected to severe environmental excitations. On the other hand, uncertainties are involved in both the structure itself and environmental loads. To ensure the safety and serviceability of the system, reliability assessment and probabilistic design methods become critical, which are the main concerns of the special session. Contributions related to both fundamental research and to engineering applications are welcome. Topics of interest include:
(1) Stochastic modeling of offshore environmental loads.
(2) Predictions of long-term extreme loads and fatigue loads of offshore wind turbines.
(3) Risk and reliability analysis of offshore wind turbines.
(4) Reliability-based (optimization) design of offshore wind turbines.
(5) Structural analysis under extreme environmental conditions, e.g., tropical cyclones.
(6) Prediction of remaining life and life extension of wind turbines.
Other relevant topics are welcome as well.

15:30-16:00 Arts Concourse

Tea/Coffee Break

Tea/Coffee Break

16:00-16:45 Ed Burke, Level 1

Plenary

Keynote Session

Chairs: Prof. Alan O'Connor & Prof. Vikram Pakrashi

16:00-16:45 Robert Emmet, Level 2

Relay of Keynote Plenary

Keynote Session

Thursday, 13 July, 2023

08:00-08:45 Arts Concourse

Registration

Registration

08:45-09:30 Ed Burke, Level 1

Plenary

Keynote Session

Chairs: Prof. Alan O'Connor & Prof. Vikram Pakrashi

08:45-09:30 Robert Emmet, Level 2

Relay of Keynote Plenary

Keynote Session

09:30-10:00 Arts Concourse

Tea/Coffee Break

Tea/Coffee Break

10:00-12:00 Thomas Davis, Level 2

MS 10: Life-Cycle Risk, Resilience, and Sustainability of Structures and Infrastructure Systems

Parallel Session

Nowadays, topics such as risk, resilience, sustainability, and life-cycle engineering have shifted into the focus of engineering societies. The sustainability and resilience of infrastructure systems are important in the long-term or life-cycle viability. Additionally, considering climate change, severities of hazards, such as hurricanes and flooding, and sea-level rise, are expected to increase. The development of an integrated resilience and sustainability-informed intelligent and robust decision support framework for the optimum life-cycle management of infrastructure systems is of vital importance. This Session/Mini-Symposium will provide a forum for international experts and researchers to discuss and exchange information on the existing and emerging technologies to support the analysis of the sustainability and resilience of all infrastructure systems and the intelligent operation and maintenance (O&M) of infrastructure systems. Topics include but are not limited to: methods, algorithms, and formulations to model and quantify resilience and aid the intelligent O&M; sustainable and green strategies in design and maintenance practices; experiments and simulations to assess the performance of low-carbon infrastructures; techniques of simulation and analysis associated with climate change; dependencies and interdependencies among infrastructure systems; risk management and adaptation to changing climate conditions; and intelligent optimizations of resource allocation for mitigation and recovery planning.

10:00-12:00 JM Synge, Level 2

MS 31: Design of Structural Systems for Robustness Against Disproportional Collapse

Parallel Session

Codified structural design is still made mainly on a member-by-member basis, with little account for system behavior. Yet, structural systems are eventually subject to extreme loads of small probability but large magnitude, which may cause localized damage, with eventual loss of load bearing elements. In this context, it is of primary importance to analyze and design structural systems to support localized damage, arresting damage propagation and the disproportional collapse of the structure.
This MS aims at bringing together scientists, academics and practicing engineers addressing theoretical aspects, experimental results, numerical modelling and practical recommendations for design against disproportional collapse. The scope of the MS is broad and covers: robustness and fragility modelling, alternate path and enhanced local resistance methods, system reliability, risk analysis, design optimization, performance-based design. Both theoretical developments and applications involving different structural systems like buildings, bridges, dams, tunnels and retaining structures are particularly welcomed in this session.

10:00-12:00 Robert Emmet, Level 2

MS 35: Uncertainty in Geotechnical Engineering

Parallel Session

Geotechnical engineering is one of the areas of engineering where there is significant presence of uncertainty at all levels, and the consequences of a poor understanding or mitigation of such uncertainty is severe. All civil infrastructure and their risks are related to this uncertainty, and this mini-symposium (MS) intends to capture the diversity and complexity of such uncertainties over a wide range, including (but not limited to) design, testing (laboratory and site), analyses and assessment. The MS also intends to investigate better and more robust methods of understanding, qualifying, quantifying and apportioning uncertainties and risks related to geotechnical engineering. We invite papers covering theory, numerical analyses, laboratory and site experimentation – as well as case studies and innovative industrial applications. Novel applications of statistics and probability, creation of new methods and assessment of existing ones will feature in this MS, as well as new interdisciplinary or multidisciplinary frontiers of analysis, testing, applications of designs demonstrating the boundaries of knowledge in this topic, along with emerging areas. This MS intends to bring scientists, practitioners and owners of infrastructure together under the common theme of geotechnical engineering, with a focus risk/safety and their interpretation in impactful areas of application.

10:00-12:00 Jonathan Swift, Level 2

MS 41: Calibration of Structural Design Codes

Parallel Session

Given the tremendous challenges our society is facing, i.e. in regard to the expected changes in our environment due to climate change and the increasing pressure on our natural resources, the international research community is in demand to find solutions that provide the foundation for our sustainable development. Here, the built environment is of obvious importance as it not only facilitates societal activity but also has a major share on the worldwide turnover of economic and environmental resources. To date the built environment is developed and maintained by broadly following structural design standards, which did evolve continuously over time and contain safety concepts that support daily structural engineering decision making based on simple calculus. The major objective that has been followed in their development, was the provision of sufficient safety, and the observed relative low failure rates do proof success in this regard.
In recent years the topic of code calibration has regained relevance due to the ongoing revisions of design standards (as e.g. the Eurocodes). But also due to evolved need for sustainable development of the built environment.
In the present symposium current developments in reliability and risk based code calibration are presented and discussed.

10:00-12:00 Mháirtín Uí Chadhain, Level 2

MS 37: Reliability Based Assessment of Structures

Parallel Session

Infrastructure owners/managers are increasingly faced with structures which fail to document sufficient load carrying capacity when assessed to codes to which they were not, in some cases, designed. The result often leads to the need for strengthening or replacement actions, which represent an unsatisfactory outcome from both economic, and sustainability perspectives. This has lead to a move to increase the adoption of reliability based methods as proposed for example in the draft Eurocode for Assessment and Retrofit of Existing Structures and in the Danish Roads Directorates Guideline for Reliability Based Classification of the Load Carrying Capacity of Existing Bridges.
This mini-symposium aims to bring together researchers and practitioners in order to present, discuss and exchange information and ideas on reliability based assessment of structures, with particular emphasis on (i) consideration of uncertainty and (ii) including considerations of sustainability in the assessment.
It is expected that the mini-symposium will provide an overview of the state-of-the-art and will help to identify areas for further developments and applications of reliability based assessment of structures.

10:00-12:00 Beckett 1, Level 1

General Session

Parallel Session

10:00-12:00 Museum 1

MS 27: Data-driven and physical-informed methods for structural reliability assessment and design under deep uncertainties

Parallel Session

Coping with uncertainty becomes a necessity in almost all practical situations in structural design. In fact, uncertainty appears on the characterization of loadings, material properties, deterioration processes, etc., and may severely affect structural behaviour. Sources of uncertainty may be classified as aleatoric (that is, randomness) or epistemic, due to lack of knowledge or imprecise information. This problem has generated significant developments on generalized approaches for uncertainty quantification with the key question of how to model these deep uncertainties, encompassing randomness and imprecision simultaneously. In many practical cases only ranges or bounds are available for some parameters so that set-theoretical descriptors provide an appropriate model. In combination with probabilistic information, this leads to imprecise probabilities. Nonetheless, practical applications of imprecise probability approaches remain challenging, as they entail considerable additional efforts when compared to their deterministic, semi-probabilistic or probabilistic counterparts. Therefore, this mini-symposium aims at bundling the most recent developments in imprecise probabilities and their application to structural design, including (but not limited to): different variants of imprecise probability analysis, such as interval probabilities, p-box approach, evidence theory, fuzzy probabilities and so forth; numerical approaches for forward and inverse uncertainty quantification; determination of probability bounds, data-driven and grey-box techniques, etc.

10:00-12:00 Museum 2

MS 5: Civil Infrastructure in a Changing Climate: from Nonstationary Risk Assessment to Developing Adaptation Strategies

Parallel Session

A warming trend has been reported by the UN Intergovernmental Panel on Climate Change since 1950s with the increasing greenhouse gas concentration, leading to sea-level rise, hotter drier summers, warmer wetter winters, more floods, increasing wind speeds, etc. Such change in climate alters the environment that built infrastructure is exposed to and poses a major threat to their safety. Various impacts of climate change on the risk to built infrastructure have been investigated by researchers in structural and building engineering.
This Mini-Symposium will bring together researchers to share the latest advances in climate change research for civil infrastructure and building adaptation. Topics of interest include, but are not limited to: (1) modeling methods for nonstationary risk of the failure of infrastructure assets and systems, including the impact on the extreme weather or climate events, structural loads and structural vulnerability, (2) assessment of the climate change impact on the risk and performance of civil infrastructure in different regions and at different temporal and spatial scales, (3) development of civil infrastructure adaptation strategies and the implementation supports, and (4) issues for stakeholders and decision-making: consideration of risk perception, acceptability of adaptation strategies, and deep uncertainty, and development of decision frameworks.

10:00-12:00 Museum 3

MS 36: Uncertainty in Traffic Data

Parallel Session

Uncertainty in traffic data is critical to the resilience of a network and associated aspects including incident response, operational efficiency & control along with policy implementation. While recent technological advancements introduced a wide range of innovative ways of data collection from traffic networks, there is a gap in understanding their uncertainties, errors and limits of interpretation. This mini-symposium (MS) intends to focus on this uncertainty as a critical aspect of traffic modelling. The impact of uncertainties, their sources and apportionments are a part of this MS, as well as case studies on various scenarios for various networks. Understanding, quantifying and interpreting uncertainty, along with novel ways to address their effects will be considered. The interaction of uncertainty with contemporary issues, including (but not limited to) connected & automated vehicles, traffic forecasting, multi-modal networks, energy consumption, climate change, and disaster management will be considered, as will be the use of novel technology to address them. Interaction of policy instruments and uncertainty, and their impact on individuals or the society is also within the remit of this MS. Overall, this MS intends to capture the gamut of complex interactions of traffic dynamics with uncertainty of observed data, acknowledging contemporary challenges.

12:00-13:00 Arts Concourse

Lunch

Lunch

13:30-15:30 Thomas Davis, Level 2

MS 19: Surrogate and Reduced Order Models

Parallel Session

Computer simulation has become central in all fields of engineering and applied sciences in the last decades. High-fidelity simulators (e.g. finite element models) are commonly used all along the design process of complex systems. However, using these models directly to optimize designs, to assess the impact of uncertainties on reliability and robustness, to pursue model calibration from experimental data or to carry out global sensitivity analysis is not feasible due to computational costs. For this reason, surrogate modelling has gained major interest in the recent years. The aim of this mini-symposium is to highlight new research trends in the field of surrogate modelling. Contributions on established techniques such as (sparse) polynomial chaos expansions, Kriging, support vector regression, sparse grid interpolation, etc. are welcome, but also data-driven approaches stemming from machine learning such as (deep) neural networks, random forests, etc. Topics of interest include, but are not limited to active learning, ensemble modelling, dimensionality reduction. Significant applications in new or emerging fields are also welcome.
Uncertainty quantification (UQ) of engineering structures remains a computationally expensive task, although significant achievements have been made in computing technology. UQ in forward and inverse problems requires solving a discretized version of the governing differential equation multiple times. This discretized differential equation often involves significantly large degrees of freedom, making UQ a computationally prohibitive task. This mini-symposium will focus on computational challenges and the recent development of numerical methods for UQ using reduced order modeling. The scope of the mini-symposium involves topics on uncertainty quantification, inverse problem, data-driven modeling using machine learning, reliability analysis, surrogate modeling, and reduced-order modeling. Applications of the developed methods to structural and fluid dynamical systems are also encouraged.

13:30-15:30 JM Synge, Level 2

MS 26: Advances in methods for global reliability of complex structures

Parallel Session

Complex structures in engineering practice inevitably encounter uncertainties, which might be stemmed from structural parameters or/and dynamic excitations. Therefore, stochastic dynamics and reliability evaluation are needed to capture the performance and safety of practical complex structures. The past two decades have witnessed important advances in the uncertainty quantification and probabilistic modeling of structural parameters and external excitations, physical-mechanics basis for refined performance and behavior analysis, uncertainty propagation and stochastic dynamics, and global reliability assessment of complex structures. However, great challenges still exist in in this field. This mini-symposium aims at providing a platform for the exchanges on the state of the art and of the practice, challenges, and new tendency in methods for dynamic response and global reliability of complex structures. The papers with the following and pertinent topics are welcome:

13:30-15:30 Robert Emmet, Level 2

MS 33: Inspection and Monitoring of Built Infrastructure

Parallel Session

Inspection of built infrastructure systems (e.g. bridges, pipelines, wind turbines) generates data at various levels, with different accuracies and uncertainties. This mini-symposium (MS) intends to focus on this significant variation of data obtained through visual inspection along with destructive or non-destructive testing. Subsequently, the MS also intends to investigate the appropriateness of various statistical and probabilistic methods applied to these data types, along with fusion of such data. Additionally, the collection of papers in this MS is expected to focus on developing guidelines of choice of data, along with related methods of analyses. The approach is expected to focus on both traditional and emerging methods of inspection, along with analysis. The impact of such analysis can be felt for individual components of structures, individual structures or a collection of structures, including their presence in a network. The MS intends to cover all this an emphasize of the rapidly evolving area of data obtained from infrastructure and assess its value for decision-making. We expect this MS to focus on both methodology and practical case studies. It intends to represent a snapshot of this sector at a critical time of change and open up new ideas and trends for researchers and practitioners.

The aim of this symposium is to collect and share high-quality research on the application of Artificial Intelligence (AI) for railway infrastructure monitoring. Due to prompt loading and unloading over tracks, the tracks, and sleepers experience fatigue as well as crack damages that results in uneven traversing of trains and carriages. Traditionally, manual inspection or track recording vehicles are used to monitor each length of railway network to maintain the quality of infrastructure. Although, these techniques are commonly used but they are labour-intensive and require excessive time to complete the process especially as the railway networks are widely spread. AI and Machine learning techniques have recently shown to be feasible approaches for structure monitoring that create models of neural network and trained them to detect changes in the railway components. Therefore, this symposium focuses on the application of AI for railway infrastructure monitoring and disseminate high quality research in this field. This will encompass all the components of railway infrastructure that may require continuous monitoring for sustaining operations, including the track quality, sleepers' condition, railway bridges, ballast removal and train loadings, etc. This symposium targets the papers that uses the latest AI and machine learning approaches to assess railway condition.

13:30-15:30 Jonathan Swift, Level 2

MS 11: Multi-hazard risk modelling: beyond conventional approaches

Parallel Session

The last few decades have seen an increase in the development and application of risk modelling frameworks to quantify the impact of natural and human-made hazards. However, state-of-practice models continue to be limited since they typically: capture the effects of a single hazard; represent risk exclusively in terms of economic losses; and are only suitable for uncoupled assets (neglecting networked infrastructure). Furthermore, the application of these models beyond traditional risk management users, such as insurers, remains largely underexplored.

This symposium will explore opportunities for addressing these shortcomings, paving the way towards a shift in how we approach risk modelling. We welcome innovative contributions including but not limited to: (a) loss-based design of assets for single or multiple hazards; (b) user-centred approaches for system-level disaster risk reduction decisions; (c) methods for modelling functional recovery of the built environment; (d) risk metrics that acknowledge the disproportionate impacts socially-vulnerable communities hold; (e) quantification of dynamic risk to account for the time-dependent uncertainty inherent in hazard, exposure, and vulnerability; (f) and multi-risk approaches that capture realistic multi-hazard interactions within hazard, vulnerability, and exposure. A review paper featuring selected presentations from this symposium is planned in the International Journal of Disaster Risk Reduction.

13:30-15:30 Mháirtín Uí Chadhain, Level 2

MS 8: Recent Advances in Stochastic Engineering Dynamics

Parallel Session

Ever-increasing computational capabilities, novel signal processing techniques, and advanced experimental setups have contributed to a highly complex modeling of engineering systems and related excitations. Examples include diverse nonlinearities, hysteresis, joint time-frequency representations, and fractional derivative models. In many cases even the deterministic solution of the corresponding governing equations is an open issue and an active research topic. Clearly, solving the stochastic counterparts of these equations becomes even more challenging, especially for high-dimensional systems.
The objective of this MS is to present recent advances and emerging cross-disciplinary approaches in the broad field of computational methods for stochastic engineering dynamics. Further, this MS intends to provide a forum for a fruitful exchange of ideas and interaction among diverse technical and scientific disciplines. Specific contributions related both to fundamental research and to engineering applications of stochastic dynamics and signal processing methodologies are welcome. A non-exhaustive list includes joint time-frequency analysis techniques, sparse representations concepts and tools, stochastic/fractional calculus modeling and applications, nonlinear stochastic dynamics, stochastic model/dimension reduction methods, Monte Carlo simulation schemes, and risk/reliability assessment applications.

13:30-15:30 Beckett 1, Level 1

General Session

Parallel Session

13:30-15:30 Museum 1

MS 1: Data-Driven Risk Assessment of Structures and Infrastructure against Natural Hazards

Parallel Session

Structural and infrastructure facilities have been increasingly affected by natural hazards due to the ever-changing built and climate environment where aleatory and epistemic uncertainties are involved in both the structures and hazard loads. In that respect, developing reliable risk-informed approaches for structural loss quantification plays a central role in high-confidence decision-making. Existing approaches can be generally classified into physics-based and data-driven ones. The former is often characterized by solid physical bases whereas the latter has been found efficient and robust, especially for regional-level risk assessment of communities that comprise various structures and infrastructure against multiple hazards.
To move forward the frontier of data-driven risk assessment of structures against natural hazards, this mini-symposia provides an opportunity for researchers and engineers to present their recent achievement and insight/thoughts on future directions. Fundamental research and practical applications are both welcome. Pertinent topics include, but are not limited to:

13:30-15:30 Museum 2

MS 39: Climate-resilient infrastructure networks: modeling and evaluating resilience enhancing interventions

Parallel Session

Infrastructure networks are susceptible to hazard events that affect their serviceability leading to direct and indirect consequences for the society. This necessitates network managers to regularly assess the resilience of their system, and make decisions on if/what interventions can be implemented to meet resilience objectives. This need is becoming ever more prevalent in the case of climatic hazards, e.g., heavy rainfall and flooding, as their frequency and severity have been increasing due to climate change. Evaluating the effectiveness of interventions in enhancing the resilience of networks under climatic hazards, however, is a substantially challenging task. This is largely due to the 1) complex and uncertain spatiotemporal nature of climatic hazards, 2) complexities and uncertainties in predicting their impact on infrastructure networks, considering the interdependencies, and 3) modeling interventions considering their interaction with hazards and infrastructure networks and hence, evaluating their impact on enhancing resilience.
This session provides a platform for the involved researchers in the fields of risk and resilience of infrastructure networks to present their recent advancements and exchange their ideas. The session will be mainly focused on modeling and evaluating the effect of interventions on enhancing the resilience of infrastructure networks against climatic hazard events.

13:30-15:30 Museum 3

MS 42: Uncertainties in hydrology and scour risks

Parallel Session

Bridge failure due to scour can be instantaneous and occur without any warning, the risk will worsen due to climate change. It is critical that asset owners have tangible solutions and accessible processes which can be put in place for the inspection, assessment and monitoring of assets that are at risk of scour. This session is focused on advances which can contribute to the development a national framework for scour risk assessment incorporating SHM and probabilistic approaches.
The temporal and spatial variability and associated uncertainty in hydrological and hydro-meteorological variables such as precipitation, runoff, soil moisture, and humidity need to be quantified for applications such as flood forecasting and risk assessment, water resources management, the impact of climate and anthropogenic changes, as well as the development of hydrological models. This session aims to invite contributions to innovative research on uncertainty in hydrological studies, including advanced applications, quantification of uncertainty, sources of uncertainty, and modeling of spatio-temporal variability of hydrological processes.

15:30-16:00 Arts Concourse

Tea/Coffee Break

Tea/Coffee Break

16:00-17:00 Ed Burke, Level 1

Closing Plenary

Keynote Session

Chairs: Prof. Alan O'Connor & Prof. Vikram Pakrashi

16:00-17:00 Robert Emmet, Level 2

Relay of Keynote Plenary

Keynote Session