Dear PSAM 11 & ESREL 2012 participant,

ESRA and ESReDA are jointly sponsoring a workshop on the Saturday morning following the conference, 30th June. This will take the form of a series of 6 lectures on the state of the art from leading figures in the field of risk and reliability, aimed at young researchers starting their careers and those from industry who wish to broaden their knowledge.

Each lecture will be 2 hours in total and there will be two sessions, the first 9am-11am and the second 11am-1pm, with 3 parallel lectures in each.

Registration is FREE!

All of the lecturers and topics are now confirmed and they are

- Dr Piero Baraldi and Prof. Enrico Zio, Politecnico di Milano
  "Prognostics and Health Management with Industrial Applications"
- Prof. Tim Bedford and Dr Kevin Wilson, University of Strathclyde
  "Structured Expert Judgement in Risk and Reliability"
- Prof. Emanuele Borgonovo, Bucconi University
  "Importance Measures and Sensitivity Analysis in the Theory of Risk and Reliability"
- Prof. Marko Cepin, University of Ljubljana
  "Assessment of Power System Reliability – Methods and Applications"
- Dr Cen Nan, University of Duisberg-Essen
  "How to Build a Distributed Simulation Platform in order to Combine Different Modelling Approaches for Reliability/Risk Analysis of Complex Systems"
- Prof. Raphael Steenbergen, TNO, Netherlands Organisation for Applied Scientific Research, Delft
  "Risk and Reliability in Civil Engineering: Beyond the Horizon"

The lectures have been allocated into three tracks with the idea being that each participant will follow one of the tracks. The tracks are

- Track 1: 9am-11am Emanuele Borgonovo, 11am-1pm Tim Bedford and Kevin Wilson
- Track 2: 9am-11am Raphael Steenbergen, 11am-1pm Marko Cepin
- Track 3: 9am-11am Piero Baraldi and Enrico Zio, 11am-1pm Cen Nan

The abstracts for the lectures can be found on the next pages.

Registration for the workshop has been extended to Friday 25th May. There are still a few places available in all three tracks. To register for this unique and prestigious event send an email indicating your attendance and track to kevin.j.wilson@strath.ac.uk. Remember, registration is FREE!

For any further information please contact kevin.j.wilson@strath.ac.uk

Regards

Tim Bedford, Terje Aven and Kevin Wilson

Abstracts for the Tracks

Track 1

Importance Measures and Sensitivity Analysis in the Theory of Risk and Reliability
Emanuele Borgonovo, Bucconi University

The purpose of the lecture is to present participants with the state-of-the art and recent advances in the theory of importance measures for risk and reliability analysis. The preliminary part of the lecture will synthetically review the principles of risk analysis, so as to provide the broad picture in which sensitivity analysis and importance measures play their role, pinpointing the applications where they are best used. We will then cover both coherent and non-coherent systems, showing a recent result that abates the formal differences in dealing with the two system types. Classical methods (Fussell-Vesely, Risk Achievement Worth, Birnbaum, Differential) and global methods, whose use is coming up recently (e.g., variance-based, the delta-importance measure) will be touched. We will show applications in the safety assessment of NASA lunar space mission models, and, at last, topics in seismic risk assessment, which are challenging, because they require to address epistemic and aleatory uncertainty simultaneously.

Structured Expert Judgement in Risk and Reliability
Tim Bedford and Kevin Wilson, University of Strathclyde

Expert judgment is the use, of structured or unstructured inputs from different individuals who have specialist knowledge of a particular domain in models such as those employed in engineering. In this lecture we consider general ideas around expert judgment and its specific role in risk and reliability. It can be used as an aid in problem structuring, model bounding, model structuring and model quantification. The application of structured expert judgment methods is typically concerned with situations in which available data are considered insufficient. A good example of this is management decision making under uncertainty in which we wish to choose between the set of decisions we could take without empirical data on the consequences of those decisions. We shall consider the specific area of model quantification. When there are multiple experts we need some way of combining the judgments of individual experts to produce a single final model. This can be achieved using a process known as aggregation.

We consider 3 case studies to illustrate different application areas of expert judgment in risk and reliability. These are concerned with predictive reliability, influence diagrams and decision making for risk and safety levels. The case studies flag up certain issues in structured expert judgment. One is the common biases associated with eliciting expert knowledge and, within this, the types of questions we can expect experts to be able to answer. A second is model validation. In the case study associated with influence diagrams we return to the issue of the aggregation of judgments. We discuss methods for achieving consensus and contrast them with formal mathematical models, and in particular Cooke's model, for aggregating the judgments of different experts.

Track 2

Risk and Reliability in Civil Engineering: Beyond the Horizon
Raphael Steenbergen, TNO, Netherlands Organisation for Applied Scientific Research, Delft

Civil engineering structures form an essential part of every day life and a large part of the invested capital of a society. Central task for the continued success of society is the development and management of civil infrastructure such as traffic infrastructure, housing, power generation, power distribution systems, water defense and water distribution systems. Reliability is a great concern because failures may have significant financial consequences and may result in injuries and loss of lives.

Design, manufacturing, execution, operations, maintenance, renovation and decommissioning decisions should be made in an optimal way considering all possible positive and negative consequences. The main objective from a societal perspective is to improve the quality of life of the individuals of society both for the present and the future generations. From the perspective of individual projects the objective may be to obtain a maximal positive economic return of investments. Decision making for the purpose of assessing and managing risks should be seen relative to the occurrence of hazards; i.e. risk management in the situations before, during and after the events of hazards. Risk in this context is a measure for the adverse effects of system malfunction in combination with the corresponding occurrence probability in the time span considered; the most commonly used risk measure is the integrated product of all consequences and probabilities. In practice, all relevant parameters have a stochastic nature and should as such be included in the analyses. The implication and significance of the model selection itself, the uncertainty in model and schematization and the choice of parameter values in a probabilistic design is of huge importance for a safe application in the built environment. Today there is a wide range of techniques in development to assess risk and reliability, both in relation to safety and in the wider sense. These techniques underpin legislation on safety and have relevance over a broad spectrum of activities, where risk and reliability are key concerns. Although perfection is neither physically possible nor financially feasible, probabilistic design makes it possible to design safe and reliable structures while avoiding costly over-design.

Assessment of Power System Reliability - Methods and Applications
Marko Cepin, University of Ljubljana

The importance of power system reliability is demonstrated, when the electrical energy is lost, no matter if the loss causes the shutdown of our companies and consequently huge economic deficits or the loss only slightly decreases the comfort of our free time at home.

Several methods, measures or indicators have been developed for assessment of reliability of power systems. A single formula or technique, which would give all the answers, does not exist, because power systems are far too complex for this to be possible. Selected methods, measures and indicators are summarized.

Generation reserve margin is a measure, which shows how the capacity of power system exceeds the peak consumption. The loss of load probability is defined as the probability of the system load exceeding available generating capacity under the assumption that the peak load is considered as constant through the day. The loss of load probability does not really stand for a probability. It expresses statistically calculated value representing the percentage of hours or days in a certain time frame, when energy consumption cannot be covered considering the probability of losses of generating units.

Assessment of distribution system includes the reliability and performance indicators such as plant availability, unit capability factor, unplanned capability loss factor, safety accident rate, safety system performance, time availability factor, capacity factor or load factor.

The distribution and transmission reliability indices include measures of outage duration, frequency of outage, number or customers involved or their lost power or energy and the response time.
Alternative method for assessment of power system reliability combines the functional tree of power flow paths and fault tree analysis features.

The mathematical representation of the methods is enhanced by examples, which highlight their practical use.

Track 3

Prognostics and Health Management with Industrial Applications
Piero Baraldi and Enrico Zio, Politecnico di Milano

Prognostics and health management (PHM) is a field of research and application which aims at making use of past, present and future information on the environmental, operational and usage conditions of an equipment in order to detect its degradation, diagnose its faults, predict and proactively manage its failures. The present lecture reviews the state of knowledge on the methods for PHM, placing these in context with the different information and data which may be available for performing the task and identifying the current challenges and open issues which must be addressed for achieving reliable deployment in practice.

Particular emphasis will be given to the use of ensembles of diagnostic and prognostic models for PHM. These ensembles build their state estimation and prediction from a combination of the estimates and predictions of a set of individual models. The individual models perform well and make errors in different regions of the parameters space; the errors are balanced out in the combination and as a result the performance of the ensemble is superior to that of its single best model. Furthermore, by exploiting the nature of the ensemble itself, it is possible to provide measures of confidence in the ensemble outcomes.

During the lecture applications of the proposed approaches to real case studies will be shown.

How to Build a Distributed Simulation Platform in order to Combine Different Modelling Approaches for Reliability/Risk Analysis of Complex Systems
Cen Nan, University of Duisberg-Essen

Complex systems, e.g., infrastructures systems, deserve increased attention as our societies simply rely on most of their goods and services they are expected to continuously supply. It is vital to get a clear understanding of these systems by conducting comprehensive reliability/risk analysis through advanced techniques such as the simulation and modeling. Generally, the approach of simulation and modeling is a way of solving problems that occur in the real world, which intend to map these problems to the world of the simulation and modeling. It seems more proficient if prototyping and experimenting with real systems are expensive or impossible. Currently, a number of model-based approaches have been widely implemented for the purpose of reliability/risk analysis of complex systems, e.g., Complex Network Theory (CNT), Agent-based Modeling (ABM), Fault Tree Analysis (FTA), etc. Due to their inherent characteristics and dynamic behaviors, it is necessary to integrate different types of modeling approaches into one simulation platform in order to fully utilize benefits/advantages of each approach and optimize the efficiency of the overall simulation.

One of the key challenges for developing such type of simulation platform is the required ability to create multiple-domain models, and effectively exchange data among these models. A distributed simulation approach, which has capabilities of solving this technical challenge by adopting the concept of modular design, has been developed. Through this approach, the overall simulation platform can be divided into different simulation modules at first, which could be domain specific or sector-specific simulation components, and then combine them in a distributed simulation environment by adopting an appropriate simulation standard such as the HLA (High Level Architecture) standard. This approach not just potentially improves the efficiency and flexibility of the developed simulation platform, but also intends to integrate different modeling/simulation techniques in the architecture of distributed networks.

Building such a simulation platform is not an easy task. The fundamental structure of the whole simulation platform needs to be re-constructed and the interface of each individually developed component must be compatible with its peer components. Time regulation among various distributed components is another technical challenge that needs to be carefully handled.

This lecture will start with the introduction of some of "widely implemented" model-based approaches for the purpose of reliability/risk analysis of complex systems and mainly focus on the presentation/discussion of the distributed simulation approach, as well as the simulation platform built based on it. In addition, technical difficulties/challenges regarding the development of this type of simulation platform and experiences searching for corresponding solutions will also be presented and discussed.