

## 6<sup>th</sup> PhD School on VULNERABILITY, RISK AND RESILIENCE OF COMPLEX SYSTEMS AND CRITICAL INFRASTRUCTURES

### T.I.M.E. Doctoral School

23-27 October 2017

CentraleSupélec, Université Paris-Saclay,  
Paris, France



### Organizing Committee

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**Supported by:** Institut des Sciences du  
Risque et de l'Incertain (ISRI)-CentraleSupélec;  
Center for RESilience and Safety of Critical  
Infrastructures (CRESCI)-Beihang University;  
Chair System Science and the Energetic  
Challenge-CentraleSupélec, Fondation  
Electricité de France (EDF), European Safety  
and Reliability Association (ESRA).

### Objectives

One of today's major challenges is to integrate the different disciplines involved in the design, operation and maintenance of complex systems. Examples are transportation systems (cars, trains, airplanes...), energy production plants (renewable energy, thermal and nuclear power...), transportation and distribution networks (energy transmission and distribution, water distribution, gas transportation, road and railway networks) etc. Company executives, project managers, operation and design engineers need to grasp the opportunities coming from these complex, integrated systems while avoiding risks, to the extent possible. Decisions must be taken in uncertain environments: then, uncertainty needs to be handled, for effective and rational decision-making.

The course aims at providing an advanced training on concepts, methods and tools for assessing and managing risks and opportunities in complex systems. The course covers concepts and methods for the evaluation, management and control of technical risks, as well as the uncertainties in the evaluations for confident decision-support. The presented approaches are notably based on Systems Analysis, Systems Engineering, Applied Mathematics and Computer Science,

The objective is to provide the adequate tools

for tackling the problem with scientific rigor. The acquired concepts, methods and tools constitute an essential part of the skills that researchers, engineers and managers must have.

In the end, the course provides the knowledge and competence need to architect and operate complex systems, i.e. to make them efficient and reliable in operation, and resilient to major hazardous events.

One key objective of the course is to engage multi-disciplinary and multi-cultural teams of students in the definition, design and development of a scientific research process in the areas of interest for the disciplines of risk assessment and uncertainty analysis. To this aim, "mixed" teams of participants with different backgrounds and Institutions of origin will be formed at the beginning of the course, and charged with the definition and statement of a research problem to be addressed. The procedures and frames of work for the development of original solutions to the problems defined by the various teams will be discussed in self-managed sessions at the end of each day. At the end of the open seminar of the last day of the course, the various teams will have to present the definitions of the problems and illustrate the research work that they intend to carry out for their original solutions. The teams will then have to continue the work throughout the following semester, with the objective of producing scientific papers

presenting the findings of the research. Once positively evaluated by the Professors of the School, these papers will be submitted to the appropriate international communities of peers for publication. Engagement by industrial partners in the monitoring of the projects will be sought. The benefits of the projects are expected to be an independent and direct exposure to: research problem definition and solution; multi-national, multi-cultural, multi-disciplinary, long-distance research work.

### Programme of teaching and key concepts

Risk scenarios, frequencies, consequences and uncertainties. Integrated deterministic and probabilistic safety assessment (IDPSA). Systemic approach to risk analysis. Uncertainty analysis in complex system modelling, risk assessment and accelerated testing. Reliability engineering and Prognostics and Health Management (PHM).

### Project Work

Multi-disciplinary and mixed teams (Politecnico di Milano, Leibniz Universität Hannover and CentraleSupélec) are going to be formed and given the task of defining, planning and conducting a research project on the topics of the Course, with the engagement of industrial partners. The project will be carried out over a period of six months. Eventually the original developments and results will be summarized in a scientific paper, which will be reviewed and, as done last year, possibly proposed for

presentation to a Conference, if of adequate quality. This project is funded by the T.I.M.E. Association, an international network of 55 Higher Education Institutions. This T.I.M.E. project proposes to experiment innovative educational formats for fostering interaction between PhD candidates and industry. The main goals are in two directions: first, to give PhD candidates a concrete overview on research and innovation activities in industry and their own potential role in the future in such contexts; second, to put industry in contact with PhD candidates from different disciplines and in an international context. The PhD candidates will work in teams to identify possible solutions, guided by the industrial researchers and by tutors, and at the end will present and discuss their results. Lectures/seminars given by social scientists on the theme of interaction (both with external parties and within team members) will be also given during the course.

### Programme

**MONDAY MORNING (11:00 – 12:00):**  
Registration

**LUNCH (12:00 – 13:00)**

Official opening of the PhD School  
Definition of the project teams  
**Gwenaëlle Guillerme, Prof. Enrico Zio**

**MONDAY AFTERNOON (14.30 – 19.00):**

Cultural and educational visit in Paris.

**MONDAY WELCOME DINNER (19.00 – 21.00)**

To be announced

**TUESDAY MORNING (09.00 – 13.00):**

A modern vision of risk assessment (4h) **Prof. Enrico Zio (CentraleSupélec/Politecnico di Milano)**

**LUNCH (13.00 -14.00)**

**TUESDAY AFTERNOON (14.00 – 18.00):**

14.00 -16.00: Tutorials + Project Work (2h) **Francesco Di Maio (Politecnico di Milano)**

**16:30 – 18:00:** Working Group Session with the presence of Industrial Partners

**WEDNESDAY MORNING (9.00 – 13.00):**

A modern vision of reliability engineering and prognostics and health management (4h) **Prof. Piero Baraldi (Politecnico di Milano)**

**LUNCH (13.00 -14.00)**

**WEDNESDAY AFTERNOON (14.00 – 18.00)**

14.00 -16.00: Tutorials + Project Work (3h) **Dr. Zhiguo Zeng (CentraleSupélec)**

**16:30 – 18:00:** Working Group Session with the presence of Industrial Partners

**THURSDAY MORNING (9.00-13:00):**

Advanced statistics (4h) **Prof. Piercesare Secchi**  
(Politecnico di Milano)

**LUNCH (13.00 -14.00)**

**THURSDAY AFTERNOON (14.00 –  
18.00):**

14.00 -17.00 Tutorials + Project Work (3h) **Prof.**  
**Simone Vantini (Politecnico di Milano)**

**17.00 -18.00 Presentation preparation**

**THURSDAY EVENING DINNER  
(18.00 – 21.00)**

- Panel discussion (Round table with corporate partners) and Presentation and discussion of the team project proposals

**FRIDAY MORNING (9.00 – 13.00):**

Reliability and resilience of critical infrastructures by means of survival signature in uncertain environments (4h) **Prof. Michael Beer and Matteo Broggi (Leibniz Universität Hannover)**

**LUNCH (13.00 -14.00)**

**FRIDAY AFTERNOON (14.00 –  
17.00):**

Critical infrastructure resilience modeling and optimization (4h) **Dr. Yiping Fang (CentraleSupélec)**

**Contact for Registration:**

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