Course participants

The course is mainly dedicated to control, process, quality and maintenance engineers, data scientists, data miners, researchers and PhD students in the area of Reliability, Availability, Maintainability (RAM) and fault diagnostics and Prognostics and Health Management (PHM).

Training Format

Lectures will be held in English. All participants will receive a complete set of the presentation slides with specific examples and case studies, selected reference lists and resources in electronic format, and a participant certificate.

The first part of the course is devoted to the presentation of advanced methods for the availability, reliability and maintainability analysis of complex systems and for the development of Prognostics and Health Management (PHM) and Condition-Based Maintenance (CBM) approaches. In this respect, the basics of Monte Carlo Simulation, nonlinear regression and filter models (Artificial Neural Networks, Principal Component Analysis, Auto-Associative Kernel Regression, Ensemble Systems, Hilbert Huang and Wavelet transforms) and evolutionary optimization methods (Genetic Algorithms) are illustrated. In the second part of the course, exercise sessions on Monte Carlo simulation, Artificial Neural Networks and Genetic Algorithms provide the participants with the opportunity of directly applying the methods to practical case studies. Finally, in the last part of the course, real applications of the advanced methods illustrated in the course are presented. The applications range from the evaluation of maintenance costs taking into account the reliability and availability of equipment, to the application of Monte Carlo Simulation for system availability analysis and condition-based maintenance management, to the use of regression and classification techniques for fault detection, classification and prognosis in industrial equipment.

Course location and date

The course will be held in November 2018 in Politecnico di Milano, Campus Bovisa, Via Lambruschini 4, Milano, Italy.

Mission and goals

In recent years, the volume of data and information available in the industry has been growing exponentially and more sophisticated and performing analytics have been developed to exploit them. This exciting situation offers great opportunities of optimized, safe and reliable productions and products, including optimal predictive maintenance for “zero-defect” production, with reduced warehouse costs and improved system availability with “zero unexpected shutdowns”. To grasp some opportunities, new system analysis capabilities and data analytics skills are needed.

The goal of this course is to provide participants with advanced methodological competences, analytical skills and computational tools necessary to effectively operate in the areas of reliability, availability, maintainability, diagnostics and prognostics of industrial equipment. The course presents advanced analytics to improve safety, increase efficiency, manage equipment aging and obsolescence, set up condition-based and predictive maintenance.

Contents

Methods:
- Statistical techniques for system reliability/availability estimation (Monte Carlo Simulation)
- Machine learning techniques for PHM (Artificial Neural Networks, Deep Learning, Principal Component Analysis, Auto-Associative Kernel Regression, Ensemble Systems, Hilbert Huang and Wavelet transforms)
- Decision support systems to provide the asset managers with optimal portfolios of solution choices for reliable, safe and resilient system and process design, operation and maintenance
- Models of Life Cycle Cost and optimization tools to improve the profitability of production

Exercise sessions:
- Monte Carlo simulation for system reliability/availability analysis
- Artificial Neural Networks for component fault diagnostics and prognostics

Applications:
- Evaluation of system maintenance costs taking into account the reliability and availability of equipment
- Monte Carlo Simulation for system availability analysis and condition-based maintenance management
- Regression and transform techniques for fault detection, classification and prognosis in industrial equipment

Lecturers [to be confirmed]:

- Piero Baraldi (PhD)
  Associate professor
  Energy Department
  Politecnico di Milano

- Francesco Cannarile
  Research Consultant
  ARAMIS Srl, Milano

- Michele Compare (PhD)
  PostDoc Researcher
  Energy Department
  Politecnico di Milano

- Francesco Di Maio (PhD)
  Assistant professor
  Energy Department
  Politecnico di Milano

- Marco Rigamonti (PhD)
  Research Consultant
  ARAMIS Srl, Milano

- Enrico Zio (PhD)
  Full Professor
  Energy Department
  Politecnico di Milano

Director, Chair on Systems Science and Energetic Challenge, CentraleSupelec, Fondation EDF (Electricite' de France)
RAM&PHM 4.0: Advanced methods for Reliability, Availability, Maintainability, Prognostics and Health Management of industrial equipment

XXI Edition

**Registration Form**

Return the registration form before September 2018 to courses-deng@polimi.it enclosing a copy of the bank transfer. Minimum number of participants: 6. Maximum number of participants: 25. In case the course is canceled because of insufficient number of registered participants, the registration fee will be reimbursed.

**Name & Surname**

**Title**

**Position**

**Company**

**Address**

**Phone**

**E-mail**

**Date & Signature**

I authorise the processing of my personal information under D.Lgs. 196/03.

➢ **DO YOU NEED THE INVOICE?**

- YES [ ]
- NO [ ]

**IN CASE OF INVOICE ISSUED TO YOUR COMPANY, PLEASE PROVIDE THE FOLLOWING INFORMATION** (in CAPITAL LETTERS):

- **Company Name**
- **Legal Address**
- **VAT Number**

**IN CASE OF INVOICE ISSUED TO YOURSELF, PLEASE PROVIDE THE FOLLOWING INFORMATION** (in CAPITAL LETTERS):

- **Personal Address**
- **VAT Number or Fiscal Code**
- **Date and place of birth**

**Organizer institute:**

Energy Department,
Politecnico di Milano

**Course directors**

Piero Baraldi and Enrico Zio

**Duration**

4 days

**Location**

Politecnico di Milano, Via Lambruschini 4
20156 Milano, Italy

**Number of participants: 20**

The registration fee is € 1400 (full registration fee), € 800 (PhD students) to be paid via bank transfer:

- Beneficiary: Politecnico di Milano - Dipartimento di Energia
- IBAN: IT90C05690162000001880X58 SWIFT: POPOIT22
- Banca Popolare di Sondrio – Agenzia 21 - Via Bonardi, 4 - 20133 Milano

- statement to specify on the payment: “Advanced methods for Reliability, Availability, Maintainability, Prognostics and Health Management of industrial equipment - your name”.

PHD STUDENTS SHOULD ATTACH TO THE REGISTRATION FORM THE PHD ENROLLMENT CERTIFICATION PROVIDED BY THEIR UNIVERSITY.

**Sponsorship:**

- ESRA (European Safety and Reliability Association)
- RISE (Joint Laboratory of Risk Science and Engineering), CentraleSupelec, Paris, France
- IEEE – Reliability Society, Italian Chapter
- ARAMIS Srl, Milano, Italy
- Chair on Systems Science and the Energy Challenge, Fondation EDF, Ecole CentraleSupelec, France
- Cluster S2D2 (Cluster Security, Safety, Defense, Disaster Management and Recovery) of Politecnico di Milano
- CRESCI (Center for Reliability and Safety of Critical Infrastructures), Beihang University, Beijing, China
- IEEE – Reliability Society, Italian Chapter
- RISE (Joint Laboratory of Risk Science and Engineering), CentraleSupelec, Paris, France and Beihang University, Beijing, China

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**November, 2018**

**Politecnico di Milano**

**Energy Department**

**Sponsorship:**

- ESRA (European Safety and Reliability Association)

**Support:**

- ARAMIS Srl, Milano, Italy
- Chair on Systems Science and the Energy Challenge, Fondation EDF, Ecole CentraleSupelec, France
- Cluster S2D2 (Cluster Security, Safety, Defense, Disaster Management and Recovery) of Politecnico di Milano
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- IEEE – Reliability Society, Italian Chapter
- RISE (Joint Laboratory of Risk Science and Engineering), CentraleSupelec, Paris, France and Beihang University, Beijing, China

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