1SC4192 – Flood risk management for an electricity production system

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Department: DOMINANTE - GRANDS SYSTÈMES EN INTERACTION
Language of instruction: ANGLAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 40
On-site hours (HPE): 27,00

Description

The operator of electricity production facilities EDF's mission is to make the best use of its system, over time, in order to produce the electricity required in its load plan as profitably as possible and in complete safety.

One of the major challenges of risk management in this sector of activity is the forecasting and anticipation of the effects of natural disasters, and more generally, rare events having an impact on the proper functioning of infrastructures. Optimal risk management involves predicting hazards, that is to say initiating events likely to create dysfunctions, analyzing their consequences and implementing barriers to mitigate their effects.

The objective of this project is to reproduce the optimization of a risk management approach on a use case. This involves dimensioning the height of a dike which constitutes a protective barrier against the risk of flooding for a nuclear power plant located along a river.

The risk analysis is carried out on the basis of historical flood data and a physical flow model making it possible to calculate the height of the overflow. Decision-making regarding the height of the dike is optimized from a cost model taking into account investment costs, maintenance costs, and costs in the event of flooding

Quarter number

ST4

Prerequisites (in terms of CS courses)

1SC4110 - System Monitoring, Pronostics and Risk Analysis

Syllabus

The project contains two main elements on which the study should be based:

• A physical description of the bank, the dike and the overflow phenomenon

• Incomplete flood data over a period of 30 years

The study is divided into three work-packages (WP) :

• A first WP concerns the use of historical data to predict the possible level of the river over a period of 30 years. From the point of view of the engineer in charge of the study, it is necessary to manage the fact that the data are incomplete and to be able to assess the quality of the predictions, in particular for the occurrence of extreme and rare events (very high levels of floods).

• A second WP concerns the use of a physical model to size the dike by propagating the uncertainties on the parameters of the model and on the possible flood levels. From the perspective of the engineer in charge of the study, it is necessary to set up a Monte Carlo simulation procedure and assess its quality.

• A third WP concerns the use of a cost model. From the perspective of the engineer in charge of the study, it is necessary to provide reliable decision indicators (optimal height of the dike) with associated uncertainties.

Class components (lecture, labs, etc.)

Projet-based learning

· Part 1: Introduction to concepts and issues (an EDF speaker).

· Part 2: implementation of statistical methods on flood data and physical models and Monte Carlo simulation

Grading

Oral presentation and evaluation of the project along the week

Resources

1 room for 30 élèves, overhead projectr, partition by groups
Software : Matlab/Simulink (network licence – wifi preferably) on individual PCs for each student; Python, …
2 academic supervisiors + 1 expert from EDF
Involvement of EDF over the entire week

Learning outcomes covered on the course

At the end of this course the students will be able to :

• understand the issue of risk management and decision-making under uncertainty

• to analyze a complex system and develop the elements of reflection allowing to provide a representation model (physical, statistical ...) of the phenomena whose demonstration is the object of the study

• to carry out the modeling process with an appropriate choice of modeling assumptions and to understand the limits of the models

• to conclude and decide on the relevance of the approach and on the performance of the proposed modeling solutions

Description of the skills acquired at the end of the course

C1: Analyze, design and build complex systems with scientific, technological, human and economic components
C.1.1: The aim is to understand and analyse a complex system and study the problem as a whole for decision-making where the economic and human dimensions are important.
The cost and human impact aspects are important for decision-makers, who will have to convince them of the economic benefits of such a solution while maintaining a high level of security or even improving it depending on the project, and to convince users of the viability and reliability of the solutions envisaged.
C1.2: Use and develop appropriate models, choose the right modeling scale and relevant simplifying assumptions to address the problem
C4: Ability to create value for your company and its customers
In this context, it will be a question of creating value for the customer by optimizing security margins

C6: Being comfortable and innovative in the digital world
C6.5 Use any type of data, structured or unstructured, including massive data.
C7: Collect relevant and reliable information to support an argument (e. g. to retrieve relevant data).