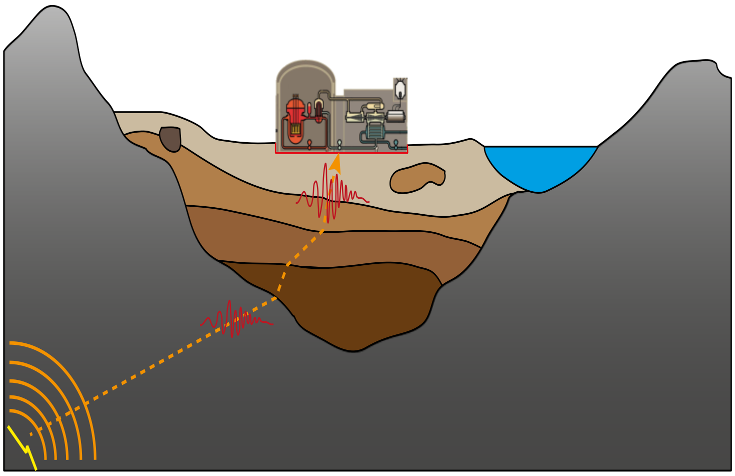
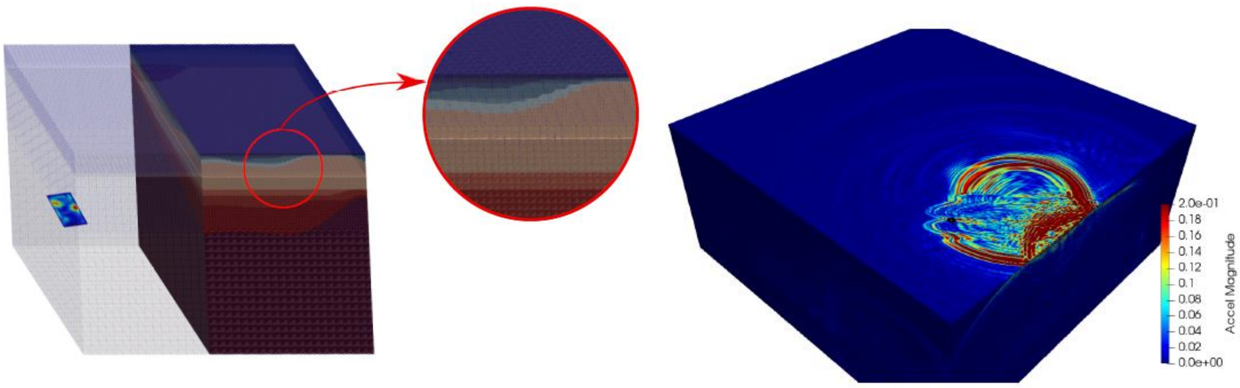
INTERNSHIP

NUMERICAL MODELING AND UNCERTAINTY HIERARCHISATION ON SEISMIC GROUND MOTIONS FOR THE SMATCH BENCHMARK

The seismic safety assessment of structures and components of nuclear power plants is based on well-established methodology consisting in the (i) establishment the seismic hazard to be retained for the geographical location of the nuclear power plant, (ii) computation of the dynamic response of structures interacting with the surrounding ground and (iii) evaluation of the seismic demand to be considered for structural and component's safety assessment. Seismic hazard studies are based on the use of empirical laws for characterizing seismic motion, established from recorded seismic ground motion databases with accelerometric network data from all over the world. In consequence the uncertainty related to such empirical models can be very high. One major challenge for nuclear safety consists in the development and improvement of site-specific evaluation of seismic load.



Following the increase in computing power in the last decades, numerical approaches based on the explicit modeling of soil volumes of several thousand km^3 are increasingly being developed to model specific and likely seismic scenarios based on the available data. Indeed, numerical simulation makes it possible to consider the specific characteristics of the site of interest, and in particular the phenomena called "site effects", linked to the modification of the ground motion in sedimentary layers near the surface on a particular site, these modifications being linked to the diffraction of seismic waves during propagation through soil layers and other geometric configurations such as the presence of a basin. In this context, comparisons between the predictions of numerical simulations and real recordings in instrumented sites is useful to gain confidence and validate the use of the in numerical models. Furthermore, given the limited knowledge on the seismic source and the propagation medium, strategies for uncertainty propagation need to be developed.



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In particular, EDF is co-organizing an international benchmark under the aegis of the OECD-NEA (SMATCH benchmark https://www.smatch-benchmark.org/) around the modeling of the Teil earthquake, magnitude Mw=4.9 which took place in mainland France on November 11, 2019 and whose epicenter is approximately 15 km from the Cruas-Meysse nuclear power plant. As part of this internship, numerical simulations using the SEM3D spectral finite element code (https://github.com/sem3d/SEM) will be carried out, to study the sensitivity of ground motion and intensity measures to the different input parameters (seismic source, regional and local geology).

Internship tasks

- Bibliography report about seismic ground motion numerical modeling and uncertainty quantification, get familiarized with numerical tools.
- Uncertainty quantification and propagation on the benchmark input data by efficient numerical methods.
- Sensitivity analysis on ground motion intensity measures (PGA, PSA, etc).
- Final report covering the numerical methods, simulation results and analyses.

The 6-month internship will take place starting on March 2024 at EDF R&D Lab Paris Saclay (Boulevard Gaspard Monge, 91120 Palaiseau, France) and in partnership with LMPS laboratory from Paris-Saclay University. The candidate will be part of the Civil, Geomechanics and Earthquake Engineering in the ERMES department at EDF R&D.

A successful candidate shall dispose strong knowledge in the following fields:

- Engineering seismology
- Structural dynamics and numerical methods (finite elements)
- Parallel computing and programming
- Statistics and probabilities

A first experience in finite element modeling and parallel computing is appreciated.

Contact :

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