2SC7691 – Optimization of a seismic exploration campaign for infrastructure protection

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Language of instruction: ANGLAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 80
On-site hours (HPE): 48,00

Description

Project topic in partnership with CEA-DAM.

After the accident in Fukushima (Japan), the use of high-performance computing has become increasingly common in estimating the seismic risk associated with nuclear power plants. These tools are of strategic importance not only in the context of the design of new installations, but also in order to study the performance of existing power plants in the face of extreme vents, not anticipated during their design. In this context, the SEISM Institute (of which CentraleSupélec and CEA are founders) was founded in 2012. It is a French scientific grouping, comprising academic and industrial partners (including CEA and EDF), with the 'objective of bringing together the various know-how in seismology and earthquake engineering to improve the prediction of the seismic response of critical sites and structures in France, as well as the assessment of the associated risk.
In this context, this project concerns the optimization of a geophysical exploration campaign on an experimental site, using its digital twin, built using a wave propagation code (SEM3D) in development between CentraleSupélec, CEA and the Institute of Globe Physics. SEM3D simulates the propagation of seismic waves over large 3D domains, with domain decomposition on a Cartesian (or spherical) mesh. It also integrates the site topography and complex geological structures. The project therefore consists of solving an inverse problem in order to optimize - using SEM3D - the geological configuration of the site of interest. This optimization is based on the *Reverse Time Migration* method (i.e. resolution by adjoint problem). The optimization strategy provides for many realistic simulations, from source to sensors (forward) and back-propagation of the misfit (backward) in order to be able to update iteratively the mechanical properties of the subsoil. Indeed, given the size of the site of interest (~10 km wide) and the spatial resolution sought (~100m), although SEM3D is parallelized and distributed on supercomputers, each wave propagation simulation can last