THREE-DIMENSIONAL PHYSICS-BASED NUMERICAL SIMULATIONS OF EARTHQUAKE GROUND MOTION FOR ADVANCED SEISMIC RISK ASSESSMENT

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Three-dimensional physics-based simulations (PBS) represent one of the most powerful techniques for the prediction of seismic wave propagation phenomena. Indeed, based on a high-fidelity level of inputs, they can provide a complete and reliable picture of the seismic wave propagation phenomenon. Here, we are interested to employ PBS to predict seismic response of structures by interfacing ground motion at a site with specific vulnerability model.
In this talk we introduce the mathematical and numerical models for the coupling of the ground motion induced by earthquakes with the induced structural damages of buildings. In order to simulate seismic wave propagation we employ the discontinuous Galerkin spectral element method [1, 2] implemented in the open-source code SPEED (`http://speed.mox.polimi.it`), whereas prediction models of structural damages are based either on empirical laws (fragility curves) or deterministic approaches (linear and non-linear differential models).
The first proposed coupled approach based on fragility curves is then tested considering synthetic physics-based scenarios with earthquake magnitude in the range $6.5 - 7.3M_w$ in the Beijing metropolitan area (China) focusing on the class of high-rise buildings [3].
In the second proposed approach, three-dimensional physics-based scenarios of the 1999 M_w6 Athens earthquake are carried out to study the seismic response of the the Acropolis hill and of the Parthenon. In particular we model the main Greek cultural heritage within the framework of the structural analysis [4].

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This is a joint work with P. F. Antonietti, C. Cauzzi, I. Mazzieri, R. Paolucci, A. Quarteroni, C. Smerzini and M. Stupazzini.

References

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