Simulating the seismic ground motion impact on large buildings: A 3D-1D Finite Element-Truss Model coupling

Amir Peiraviminaei[1] Barbara Wohlmuth[2] Markus Muhr[3] Marco Stupazzini[4] Ilario Mazzieri[5]

In this presentation, we consider one-directionally coupled 1D structures with a 3D ground motion. THE 3D Elastodynamic problem is considered for ground motion caused by earthquakes which triggers shaking in structures like high-rise buildings and bridges. Due to the population growth, the need for accommodation has led to constructing high-rise buildings and very dense Megacities. Finite Element Analysis of the dynamic displacement and motion of these structures have been studied thoroughly, in which, 3D models for the building layouts are fully integrated into the geological ground structure. We want to use 1D multi degree of freedom oscillators to represent the structures instead and study a one directional coupling of soil structure interaction. This approach is very cost efficient to implement. By increasing the amount of DoFs for any urban structure, we can simulate more realistically the impact of seismic events on whole city districts while simulation costs remain mostly at the order of the ground motion simulation alone. For this purpose, we consider first a very simple 3 DoF model with a prescribed analytical solution. After validating our Algorithm, we consider an MDoF model for a city-like environment and a bridge which are exposed to an earthquake considering A linear constitutive material law.

[1]Department of Mathematics, Technical university of Munich, Munich
peiravim@ma.tum.de

[2]Department of Mathematics, Technical university of Munich, Munich
wohlmuth@ma.tum.de

[3]Department of Mathematics, Technical university of Munich, Munich
muhr@ma.tum.de

[4]Munich Re, Munich
MStupazzini@munichre.com

[5]Dipartimento di Matematica, Politecnico di Milano, Italy
ilario.mazzieri@polimi.it