EGU22-12263
https://doi.org/10.5194/egusphere-egu22-12263
EGU General Assembly 2022

System identification of a high-rise building: a comparison between a single station measuring translations and rotations, and a traditional array approach.

Yara Rossi[1,2], John Clinton[2], Eleni Chatzi[3], Cédric Schmelzbach[4], and Markus Rothacher[1]
[1]ETHZ, Institute of Geodesy and Photogrammetry, Departement of Civil, Environment and Geomatic Engineering, Switzerland (rossiy@ethz.ch)
[2]ETHZ, Swiss Seismological Service, Switzerland
[3]ETHZ, Institute of Structural Engineering, Departement of Civil, Environment and Geomatic Engineering, Switzerland
[4]ETHZ, Institute of Geophysics, Departement of Earth Sciences, Switzerland

We demonstrate that the extended dynamic response of an engineered structure can be obtained from just a single measurement at one position if rotation is recorded in combination with translation. Such a single station approach could save significant time, effort and cost when compared with traditional structural characterization using arrays. In our contribution we will focus on the monitoring of a high-rise building by tracking its dynamic properties, e.g., natural frequencies, mode shapes and damping. We present the results of the system identification for the Prime Tower in Zurich – with a height of 126 m, this concrete frame structure is the third highest building in Switzerland. It has been continuously monitored by an accelerometer (EpiSensor) and a co-located rotational sensor (BlueSeis) located near the building center on the roof for the past year. The motion on the tower roof includes significant rotations as well as translation, which can be precisely captured by the monitoring station. More than 9 natural frequencies, including the first 3 fundamental modes, as well as the next two overtones, where translations are coupled with rotations, are observed between 0.3 – 10 Hz, a frequency band of key interest for earthquake excitation, making an investigation essential. Using temporary arrays of accelerometers located across the roof and along the length of the building to perform a traditional dynamic characterisation, we can compare the array solution with the new single location solution in terms of system identification for the Prime Tower.