The energy accumulated over thousands of years by a fault is then released in a few seconds. To understand earthquakes over long periods of time, it is not only necessary to study the characteristics of today events, but also to be able to go back in time. However, in spite of many years of research in the archives, many historical earthquakes remain poorly known. Over the last decades alternative approaches have been developed such as historical seismology, archaeoseismology and paleoseismology chasing new sources of information. Among these, historical buildings witnessed earthquakes recorded in their walls as structural disorders, repairs.
A multidisciplinary approach involving archaeology, numerical mechanics and seismology is introduced to analyse the seismic ground motions necessary to explain building repairs/disorders. The main steps are setting the evolution of an historic building over time, by identifying the repairs compatible with failure mechanisms due to earthquakes; defining a mechanical model of the building; selecting accelerograms compatible with a given earthquake; reproducing digitally the observed damages.
The test case is the medieval church of Sant'Agata, an exceptional site with many historical sources describing the damages induced by past earthquakes, and their renovation. The site is located in the Mugello basin (central Apennines, Italy), characterized by a moderate seismicity. The largest known events occurred in 1542 (Mw~6) and 1919 (Mw~6.3).
Two archaeological campaigns have been conducted, along with an in-depth study of historical texts, allowing to reconstruct the building evolution along the centuries (materials, construction phases, repairs) and to identify the mechanical failure modes.
A mechanical model of the church whose geometry is based on the laser scanner data and the constructive phases previously identified has been defined. An ad hoc meshing code has been developed to merge archaeological and geometric information.
Concerning the mechanical behaviour, instrumental campaigns has been organized to characterise the building vibration modes from the seismic noise recordings. These measurements are used to update the numerical model.
Initial results demonstrate the strength of the proposed methodology. The next steps are the refinement of the mechanical model and the implementation of a first set of dynamic analysis to characterize each historical ground motion.