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Elastic properties time variations of a medieval masonry structure: the Garisenda tower in Bologna

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We analyse the continuous seismic recordings from two seismometers installed at the base and on top of the Garisenda, a medieval masonry tower in the city center of Bologna, Italy. The installation lasted more than six months, from September 2013 to April 2014, thus recording any possible daily, weekly, and seasonal variations in the structural properties. We aim to perform Structural Health Monitoring of the tower by measuring the time lapse propagation velocity changes along these months. Analysis of Impulse Response Function (IRF), computed from the deconvolution of the base recordings with the roof ones, show that wave propagation through the tower is significantly dispersed. Therefore, we estimate the propagation velocity through the structure by fitting a Timoshenko beam model, which captures the dispersion in the tower for long wavelengths. Thus, for every hour of recordings, we compute the Timoshenko beam parameters -its longitudinal and shear wave velocities- by matching, in the least squares sense, low pass filtered observed and modelled IRFs. We find that the propagation characteristics of the masonry walls are mostly affected by the anthropogenic noise due to the traffic, with up to a 1% variation in seismic velocity between midnight in the holidays and midday of the working days.