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# Towards numerical models for seismic and Newtonian noise due to anthropogenic sources

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Anthropogenic or human-induced noise sources such as road or railway traffic, wind turbines, and mining or industrial activities generate ground vibration in a frequency range between 1 and 80 Hz (depending on the source type). The impact of this seismic noise on the operation of the Einstein Telescope can be reduced by hanging the mirrors in suspension towers. However, waves propagating in the soil also generate density fluctuations leading to seismic Newtonian noise (NN), which cannot be shielded and is an important noise component between 1 and 10 Hz.

We aim to develop numerical models for the prediction of ground-borne vibration due to several anthropogenic noise sources. Our first focus is on railway traffic, as multiple freight and high-speed lines pass through the Euregio Meuse-Rhine (EMR). We predict vibration levels due to train passages at several distances from the track, both at the free surface and at depth. The analysis is performed for passenger, freight and high-speed trains.

In a second step, a numerical model for the prediction of seismic NN is developed. The soil domain surrounding the cavity containing the test mass is discretized with finite elements (FE). The incoming wavefield generated by the train passages is imposed as Dirichlet boundary conditions at the edges of the FE mesh, and the scattered wavefield due to the presence of the cavity is computed. Subsequently, the NN caused by the scattered wavefield is computed using the Gaussian quadrature rule. The model is validated by predicting NN due to plane P- and S-waves propagating in a homogeneous medium, for which analytical expressions are available. Since an FE mesh is used, the model offers flexibility in terms of size or shape of the cavity and of soil heterogeneity.

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