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Seismic radiation patterns of mine blasts

Florian Bleibinhaus and Bernd Trabi
MU Leoben, Applied Geophysics, Applied Geosciences and Geophysics, Leoben, Austria
(florian.bleibinhaus@unileoben.ac.at)

Seismic vibrations induced by mine blasting are often a nuisance to residents and may even threaten the integrity of sensitive structure in the vicinity of mines. In this study we investigate the potential to reduce such vibrations through the interference with a second blast sequence. Assuming perfectly repeatable source wavelets and an acoustic, homogeneous model, we predict the radiation patterns of blast sequences with the Fourier shift theorem as a function of azimuth and incidence, and we benchmark those predictions with observations from a seismic array deployed at the iron ore mine Mt Erzberg, Austria. We then use our model to optimize the delay times of blast sequences with an inverse algorithm geared towards minimizing the predicted vibrations in certain target zones. Due to its symmetry, a single row of blasts has no azimuthal reduction potential. A second, quasi-simultaneous mine blast can, however, reduce blast-induced vibrations by up to 20% according to our model. In this study, we discuss the principles and the potential of this approach to vibration reduction. In a second study, we will present applied results obtained with a fully elastic model.