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Radiation Characteristics of Seismic Source Arrays

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Blasting operations in quarries are accompanied by ground vibrations which can endanger buildings nearby. A production blast is made of several holes with a small distance to each other, which are blasted with a time delay, to reduce the ground vibrations. These production blasts produce a specific radiation pattern. It would be favorable to focus the ground vibrations to a less dangerous direction or area. To optimize the radiation pattern of seismic waves the blast configuration can be modified. For the optimization an analytic solution, based on Fourier shift theorem can be used. This assumes a model with a homogeneous half space and similar source wavelets for low frequencies. Because we want to predict the ground vibrations for a more realistic inhomogeneous case, a numerical forward modeling on a 3D model of mount Erzberg was performed with a 3D elastic code with topography. The 3D model of mount Erzberg is the result of a tomographic travel time inversion. One problem is that the spectral response of a single blast is unknown and therefore we had to find a transfer function which transfers the numeric spectral response to the observed spectral response. After applying the transfer function the amplitude spectra of the numeric solution show a good match to the amplitude spectra of the observed production blasts. The main goal is to reduce the ground vibrations at sensitive areas. This is achieved by blasting simultaneously two blast arrays with a greater distance to each other with optimized time delays. To optimize the time delays we developed a global search algorithm, based on Marcov chain Monte Carlo method which finds potential blast configurations, with minimum impact to critical locations nearby the quarry. These blast configurations serve as proposal for real production blasts at mount Erzberg. This study is part of the EU-funded project SLIM (Sustainable Low Impact Mining, www.slim-project.eu).