Attenuation from direct waves of (micro-)seismic events.

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Seismic ray theory in combination with a model of source spectra (e.g., a model of Brune, 1970) can predict frequency content of the observed seismic waves. Specifically in this study I discuss a peak frequency resulting from combination of the source, propagation and the receiver effects. By the peak frequency I understand the frequency of the peak amplitude spectra of a seismic wave. I show that for low frequencies, i.e. below the corner frequency, the propagation effects, and specifically attenuation, controls the peak frequency in observed seismograms of seismic waves. Eisner et al, (2013) show that the peak frequency can be simply evaluated as

$$f_{peak} = 1/(\pi t^*),$$

Where *t** is the global attenuation factor (Červený, 2001). This model is consistent with observed data along surface profiles explaining difference between the peak frequencies of P- and S-waves as well as peak frequencies of microseismic events recorded on downhole monitoring arrays.

Furthermore, this relationship can be used to invert an effective attenuation. The effective attenuation in this sense means an average attenuation coefficient along the ray trajectory, although generalization to attenuation tomography will be discussed. I also benchmark attenuation inversion using the above relation with more established attenuation inversion techniques such as spectral ratio methods and show that the above relation provides less scattered estimate of the attenuation coefficients.

The resolution of information obtained from seismic waves depends on the peak frequencies of the waveforms. Understanding of the frequency dependence of the direct waves allows us to optimally design monitoring networks, and invert effective attenuation providing unique measurement from (micro-)seismic monitoring.

References:

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