Moment-Tensor Confidence Regions from Seismic-Wave Amplitude Ratios

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Applying linear programming methods to invert seismic-wave amplitude ratios provides a robust method for determining full microearthquake moment tensors. Compared to simple amplitudes, amplitude ratios are only about half as strongly affected by bias and distortion caused by errors in assumed Earth models, and are also immune to many kinds of instrumental calibration errors.

We have extended the linear programming method to compute confidence regions for derived moment tensors. This involves adding an inequality constraint to keep the misfit function below a specified limit chosen on the basis of *a priori* estimates of measurement error, and then moving the solution in six-dimensional moment-tensor space in various specified directions as far as the constraint allows.

Inverting amplitude ratios for moment tensors using data from several geothermal areas in Iceland, Indonesia, and California shows that mechanisms often, but not always, lie systematically along a trend between the double-couple and the dipole points on the source-type plot of Hudson et al. (1989). Confidence regions computed by our new method are often elongated in the double-couple to dipole direction. This observation suggests that part of the observed systematic trend may be an artifact of measurement error. Further work is required to determine whether all of the trend can be attributed to error, and also to understand why natural earthquakes are distributed in source-type space the way they are.

Hudson, J. A., et al. (1989), Source type plot for inversion of the moment tensor, J. Geophys. Res., 94(B1), 765-774.