Maximum-Likelihood-Estimation Stacking

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Abstract/Excerpt

Common-midpoint (CMP) stacking is often done using the arithmetic mean. There are good reasons for this: it's simple, linear, and is optimal if the noise has a Gaussian distribution. Where the noise is not Gaussian, however, the mean does a poor job, resulting in a stacked section contaminated by erratic noise. By estimating the probability distribution of the noise as it varies with time and CMP, and stacking using a maximum-likelihood estimator for that distribution, we get a result which is identical to a normal stack where the noise is Gaussian, but is far cleaner where the noise is erratic.

One of the first examples of statistical estimation in seismic processing was stacking (Mayne, 1962), which summed or took the arithmetic mean of the sample values of the traces at each time point of a common-midpoint (CMP) gather. I shall refer to stacking with the arithmetic mean as “mean stacking”. It is still commonly used today since it's simple, intuitive, linear, and optimal when the noise across each time point behaves like a Gaussian (that is, normal) random variable.