Reducing the potential for spectral bias in rlpSpec

Andrew J Barbour, Robert L Parker

Abstract

Bias in power spectral density estimates of geophysical datasets may be significantly reduced by removing outliers from the dataset under consideration. In many such datasets, outliers with relatively large amplitudes may be easily identified, but datasets can often have numerous outliers which are too small to be identified visually. We show that by modeling the statistical behavior of such data as an auto-regressive (AR) process, small outliers may easily be identified and removed; consequently, the estimated spectrum more accurately reflects the true frequency content of the signal analyzed. This is demonstrated using a few sample datasets traditionally used in the geophysics community.

Keywords:

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1. Introduction

2. Using innovation to pre-whiten series

We assume the data record X_n may be modeled as the sum as a zero-mean auto-regressive (AR) process of arbitrary order, and a Gaussian noise:

$$X_n = \sum_{k=1}^{K} a_k X_{n-k} + \eta_n \tag{1}$$

where η_n is the noise. This model predicts that the AR component of the record will be serially correlated up to delay K relative to record n. We estimate the coefficients a_k by solving the Yule-Walker equations.

3. Examples