Accurate Noise Reduction for Gamma-Ray Spectrometry

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SUMMARY

Three hypotheses are tested for the pre-conditioning of airborne gamma-ray spectra to improve the accuracy of principal component-type (PC) spectral noise-reduction methods. First, I show that the distribution of the input variables (channel count rates) has little effect on the accuracy of the noise-reduction methods. Second, if there are insufficient spectra of a particular shape to form a statistically significant sample, then this shape will not be resolved by the noise-reduction methods, and will be removed as noise. However, by padding the data space with spectra exhibiting the full range of possible spectral shapes, an improvement in accuracy can be achieved. Third, the low signal-to-noise ratio in raw gamma-ray spectra limits the effectiveness of PC methods for removing the noise. If the signal-to-noise ratio in the input spectra is improved, the PC methods better remove the noise. Along-line summing of spectra improves the signal-to-noise ratio by exploiting the high correlation in signal between successive airborne gamma-ray spectra along each flight line. Summing spectra to optimum channels also improves the signal-to-noise ratio, but at the expense of spectral resolution. In both cases, spectral summing prior to the application of PC-type noise reduction results in a significant improvement in the accuracy of the noise-reduced spectra.

Key words: noise reduction, gamma-ray spectrometry, spectral smoothing, MNF, NASVD.