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Hyperspectral image filtering and implications for environmental spectra related to mining contamination: example from the S.Domingos Mine, SE Portugal

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Advanced preprocessing and processing of remotely sensed data

The removal of atmospheric components, a key factor that controls all subsequent image processing, is usually dealt through statistical or physical models. However, noise components may not be completely removed from the hyperspectral images, depending on the model(s) used and of the conditions of dataset capture. Part of this noise can be identified through its spatial structure and thus be filtered using geostatistical methods. The objective of this work is the comparison of the spectral response of calibration and noise removal from an airborne hyperspectral image, focusing in significant signatures related to environmental patterns of a contaminated former mining area.

The methodology compares the atmospherical correction using a radiative transfer model and the use of geostatistical tools in radiance dataset. Factorial kriging is the geostatistical method used. The latter is developed following the steps: *i*) A multivariate statistical analysis using a compression algorithm Minimum Noise Fraction (MNF); *ii*) Factorial kriging in the most relevant MNF bands to detect multiple scales of spatial variability and filter the noise, *iii*) An inverse MNF transform of the noise-whitened factors. The resultant synthetic image is cleared off from noise detected spatially in distinct structures. Both synthetic images are then compared focusing on relevant environmental signatures related to Acid Mine Drainage (AMD).

The case study is the former S.Domingos Mine, located in SE Portugal in the Iberian Pyrite Belt. The long term exploitation included pre-roman, roman, and modern time works, with intensive AMD that endures until today. The hyperspectral image was captured in 2000 with HyMap™ sensor while field spectra were gathered simultaneously with an ASD spectroradiometer both in radiance and reflectance. The field spectra were collected in waste mining materials**.** The hyperspectral image was atmospherically corrected using FLAASH as a plug-in to the ENVI software, as well as the multivariate analysis (MNF) and all spectral analysis. Factorial kriging was performed in ANGEODAD.

Each of the resultant synthetic images is analysed with equivalent field spectra, recognised in previous works as the most significant to assess degrees of AMD. The reflectance field spectra is compared with the atmospherically calibrated image using FLAASH software and the radiance field spectra is compared with the noise filtered image using geostatistical methods. The context in which each of the methods is used yields specific results for mining environments also is discussed.