DENOISING AERIAL GAMMA-RAY SURVEY DATA WITH NON-LINEAR DIMENSIONALITY REDUCTION


1. ARC Centre of Excellence for Autonomous Systems, Australian Centre for Field Robotics, School of Aerospace, Mechanical and Mechatronic Engineering, The University of Sydney, NSW 2006, Australia
2. Dickson Research Pty Ltd, 47 Amiens St, Gladesville NSW 2111, Australia
3. 22 Bowness Street, Kellyville, NSW 2155, Australia

Denoising aerial gamma-ray surveying makes possible the extraction of previously hidden detail. Conventional methods for denoising spectral data make strong assumptions about the levels and type of noise which reduces their efficiency. The proposed methodology cast the problem as manifold learning followed by non-linear regression. Non-linear dimensionality reduction (NLDR) is employed to compute the underlying structure of the data. By calculating the intrinsic dimensionality of the spectra, the algorithm selects dimensions that are more representative of the data while eliminating dimensions with noise. The most representative dimensions are employed to learn a mixture of linear models through Expectation Maximization. Non-linear regression is then performed using these mixtures to recover the denoised spectra from the low dimensional representation. Thus, the model makes no assumptions about the level and type of noise.

Tests performed with a synthetic survey demonstrate that data denoised with NLDR show much clearer detail in images involving uranium but only slight improvements for K and Th channel data. This has been confirmed with real surveys where subtle features involving U has been found using NLDR denoising. The NLDR method offers particular advantages in the search for uranium where combinations such as U*U/Th can be used to highlight areas of coincident high U and high U/Th ratios if cleaned data is available.