

Principal component analysis and neural networks for detection of amino acid biosignatures

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Abstract: We examine the applicability of Principal Component Analysis (PCA) and Artificial Neural Network (ANN) methods of data analysis to biosignature detection. These techniques show promise in classifying and simplifying the representation of patterns of amino acids resulting from biological and non-biological syntheses. PCA correctly identifies glycine and alanine as the amino acids contributing the most information to the task of discriminating biotic and abiotic samples. Trained ANNs correctly classify between 86.1 and 99.5% of a large set of amino acid samples as biotic or abiotic. These and similar techniques are important in the design of automated data analysis systems for robotic missions to distant planetary bodies. Both techniques are robust with respect to noisy and incomplete data. Analysis of the performance of PCA and ANNs also lends insight into the localization of useful information within a particular data set, a feature that may be exploited in the selection of experiments for efficient mission design.

Keywords: life detection, exobiology amino acids, meteorites, Murchison, neural networks, Principal Component Analysis

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