Application of Principal Component Analysis to a Data Set in the Gulf of Mexico for Stratigraphic Imaging Improvement and Facies Prediction

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Most multivariate techniques assume initial variables are independent from each other however, in most cases seismic attributes are closely related, creating data redundancy, making important to determine which attributes are truly representative of specific geologic features while reducing data dimensionality without losing information on data variability. One technique developed with that purpose is Principal Component Analysis. This method basically reduces to an eigenvalue-eigenvector problem on the covariance or correlation matrix of the initial variables. Because the sum of the eigenvalues is equal to the sum of the individual variances of the matrix, we can calculate the contribution to the total variation of the data set for each Principal Component using the associated eigenvalue. Usually we expect the first two or three Principal Components to account for most of the variation in the data set, assuming the initial variables are correlated even though they may be registered independently. This technique has been successfully applied in geoscience for facies prediction and more recently seismic noise attenuation, estimation of fault orientation and AVO attribute extraction and stratigraphic imaging improvement.

Along this paper it is proposed the use of different techniques for the calculation of the Principal Component's in a study area in the Gulf of Mexico. These techniques include the calculation of the Principal Components on the well logs, synthetic traces, horizon slices and time slices using different combinations of input attributes. It is also proposed a method to generate Principal Component volumes to correlate these results with those found at well locations.