Increased Seismic Resolution by Universal Kriging Approach

WANG, LEI, PUNNEE SIRIPITAYANANON, HUI-CHUAN CHEN, and BRUCE S. HART, Department of Management Science and Statistics, The University of Alabama, Box 870226, Tuscaloosa, AL 35487

The seismic reflection method is most intensively used in the research for the carbonate reservoir characterization. Seismic waves traveling down into the earth are reflected from interface back to receivers, thus measures the response of the subsurface in both space and time dimensions. 3D-seismic data, therefore, is needed to obtain a proper sampling of layer-cake surfaces. The measurements are then transformed to sections of the subsurface and interpreted in terms of geological structures that carry information about rock and fluid properties.

To improve the porosity prediction, seismic attributes can be integrated with other geological information and then inferred to stratigraphic and depositional interpretation. The data, along with high resolution digital seismic, are the most desired in mapping porosity from seismic data to well data. To find low resolution seismic data in the target area, geostatistical estimation method is applied. Universal kriging is used to estimate the value of a surface at many unsampled locations based on information from scattered sampling points. Traditional kriging uses variogram as a function of distance only. The technique is extended by taking both distance and direction into consideration. The variograms are modeled exponentially based on the similarity and separately due to directions and distances. By analyzing data points in different directions, spatial anisotropy in the parameters might be recognized and a better porosity prediction can be obtained. Brownian motion from fractal image analysis is also adopted to incorporate the natural variation (or heterogeneity) to the estimated porosity. The methodology will be applied to the 3-D seismic data and well data from the Appleton Field in Escambia County, Alabama.