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by M. Turhan Taner,
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Richard Uden
Rock Solid Images, Houston, Texas

Progressive Seismic Data Mining
for Reservoir Characterization

Abstract

Recent years have seen remarkable technological advances in seismic data acquisition and processing. It is now commonplace for marine vessels to acquire a terrabyte of 3D seismic data per day and for some of the larger data processing centers to achieve daily throughput in excess of 10 terrabytes of seismic data. These exponential increases in available data represent huge data management and data interpretation challenges to our industry.

There are clear similarities between the seismic exploration industry and the Internet in terms of the volume of information that is available for analysis; it therefore makes perfect sense to deploy data mining tools and methodologies developed for other industries to address the needs of the oil and gas exploration business.

"Data mining is a process that uses a variety of data analysis tools to discover patterns and relationships in data that may be used to make valid predictions" (Two Crows Corp.). The data employed for gas exploration in this study are seismic attributes, and the data enrichment process employs a neural network classification scheme.

Seismic attributes are a specific class of mathematical constructs of the propagated seismic wavefield. However, many attributes are simple numerical derivatives that provide little additional discrimination, from one to the other. The primary goal of the data mining exercise is to establish appropriate seismic attributes that, in combination, afford the maximum discrimination of hydrocarbon indicators.

The phased workflow represents a progressive information enrichment process. The initial phase, conducted in the absence of well data, generates attributes appropriate for the prospects being mined. The attributes are next organized using statistical tools to select those affording the appropriate discrimination. The next phase organizes the multi-attribute response into a manageable set of discriminating classes, thereby enriching the information content concealed in the attributes. Final phases seek to extract knowledge from the classification by calibration to known prospectivity determined from well data, yielding such properties as lithology, porosity, and fluids.

Each phase delivers a data product in its own right, so the seismic data miner can select the appropriate number of phases for the task at hand.

This seismic data mining workflow will be discussed as it applies to multiple seismic attribute volumes calculated from a 3D dataset acquired on behalf of Forest Oil Corporation over the Ibhubesi Field in the Orange River Basin, RSA.

Data mining is a process that uses a variety of data analysis tools to discover patterns and relationships in data that may be used to make valid predictions.

Biographical Sketch

DR. M. TURHAN "TURY" TANER is one of our industry's best-known and most respected figures. He graduated from the Technical University of Istanbul in 1950 with an MS in structural engineering. In 1953 he attended the University of Minnesota to continue his studies in engineering mechanics. In 1991, he received an Honorary Doctorate in geophysics from the Technical University of Istanbul.
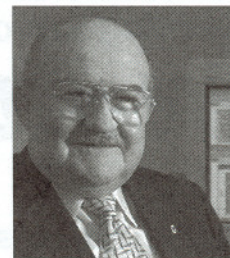
Dr. Taner co-founded Scientific Computers Inc. in 1952 and co-founded the multinational geophysical company Seiscom Delta in 1962, serving as Chairman and the Director ➢

of Research. He founded Seismic Research Corporation in 1980, a firm dedicated to developing advanced data processing technology. This company merged in 1998 with Petrosoft and Discovery Bay Company to form Rock Solid Images.

Dr. Taner has co-authored numerous papers with his associate Dr. Koehler, covering subjects such as velocity computation, wavelet estimation and shaping, seismic attributes, special band pass filters, reflection and refraction statics, computation methods, high-resolution wave equation time and depth migration, plane wave processing and imaging systems, multi-channel deconvolution, etc. The paper on seismic velocity computation has been recognized and reprinted by *Geophysics* as a classic paper. Dr. Taner is an honorary member of the Society of Exploration Geophysics and Geophysical Society of Houston. He is the recipient of the 1993 Maurice Ewing Gold Medal of the SEG and is a member of the AAPG, European Association of Exploration Geophysicists, and Institute of Electrical Engineers. In 1995 Dr. Taner in recognition for his lifetime of achievement in science and geophysics, received AGIP's 1995 Technological Achievement Award. The European Association of Geoscientists and Engineers (EAGE) awarded Dr. Taner a lifetime honorary membership in 1999.

Dr. Taner in 1988 was appointed to the Geology and Geophysics Department of Rice University, where he presently serves as an Adjunct Professor. He is currently a Senior Vice President and Chief Geophysicist of Rock Solid Images. ∎