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Compression Roaming as a Way to Address Big Data Challenge in Exploration

The industry is rethinking seismic data management and storage practices.

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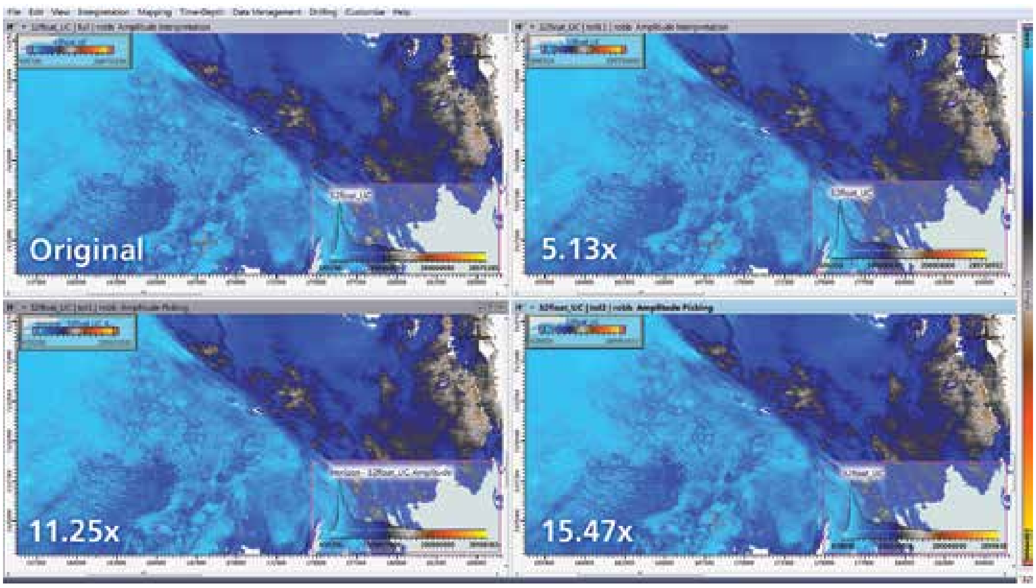
The oil and gas industry is one of the largest producers and consumers of digital data in the world. In the past few years, Petabytes of 3-D seismic data have been acquired and processed, and importantly, stored in huge disk arrays, for the most part paid for and managed by oil and gas companies themselves. In many cases, multiple copies of the same seismic data are also stored, often on local workstation disks, to accommodate limitations in some software vendors' data management capabilities. Due to their huge size, working with large seismic datasets can be extremely challenging.

The industry's answer to the big data issue has typically been to buy bigger and better workstation hardware, faster networks and faster, more capacious disk arrays. The purchase, installation and maintenance of this hardware add significantly to the total cost of ownership and operation of software platforms, especially if those platforms impose local data storage requirements on user workstations. It is apparent that this old way of working is not ideally suited to today's industry, which is currently operating under restricted budgets for acquisition, software and hardware, workforce reductions, and with less time available for users to parse through huge amounts of data. This trend is driving an industrywide rethink of seismic data management and storage practices.

To enable users to load, display, process and analyze huge amounts of data, software suppliers must continually update their solutions with the latest computing capabilities. Some of the more effective options for providing an optimal return on investment in computer hardware are the use of multiple, background threads, which can parallelize I/O of data across multiple central processing units (CPUs) and clusters of processing "blades," and utilizing the parallelization capabilities offered by modern graphics cards with their hundreds of onboard cores.

A centralized data storage infrastructure also helps to reduce the data management load on an oil company's processes and organization, as it provides users with a "load your data once" environment in which only one copy of wells, interpretations or seismic data need be stored on the system. Other techniques, such as automated selection of decimated volumes when roaming from disk, and on-the-fly seis-mic attribute calculation, help improve data loading performance and reduce the amount of storage space needed in a workstation or in the database.

Paradigm recently has released another method for managing the large data conundrum. Compression roaming enables the compression of seismic data into much smaller volumes on



Comparison of the same horizon-bound RMS amplitude extraction from four volumes with different levels of compression are shown. (Image courtesy of Paradigm)

disk. Efficient reading of seismic data into software applications is achieved through optimal use of the graphical and CPU capabilities of a workstation to parallelize the decompression of seismic volumes. Combined with the reduction in data volumes being transmitted across a network, this typically results in significant improvements in data access speeds.

Seismic compression will help companies reduce their annual outlay on disk storage and networking, and improve access speed to large 3-D seismic datasets. Typical compression ratios achieved through the use of compression utilities range from 4x to 20x or more. Compression up to about 4x is virtually lossless and adequate for quantitative workflows. Higher levels of compression correspond to higher levels of accuracy loss, but compression ratios as high as 15x or more can be adequate for structural interpretation workflows.

The compression algorithm is based on a 3-D wavelet transformation and involves no clipping or truncating of the data. Being insensitive to amplitude variations, it keeps the same quality of compression throughout the data without causing any coherent artefacts. The compressed file is decompressed on the fly prior to being used by applications to become a brick file, which is noncompressed, multiresolution and optimized for roaming in a 3-D environment.

Compression roaming provides significantly better results when compared to other industry solutions. Some examples are:

- Compression levels might be defined to address customer challenges with data storage, according to end user requirements
- 4x to 15x compression with excellent quality, suitable for common workflows
- On-the-fly decompression into applications for interactive use of seismic data

Given the importance of seismic data quality, the compression algorithm does not negatively impact amplitude, phase and frequency.

A further benefit of the compression technology offered by Paradigm is in the bit-depth of data used by consumers. No longer will data loaders and administrators have to decide in advance on the typical expected use of a seismic volume through its life cycle and determine whether to save it as 8 bit, 16 bit or 32 bit, or in more than one format. Full precision seismic data can now be stored in less space than an 8-bit volume with minimal loss of fidelity. Attribute extractions and calculations can be performed with the highest precision possible. ■