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Leveraging High Performance Computing Technologies for Real-Time Seismic Interpretation

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ABSTRACT

ABSTRACT The size of 3D seismic data is increasing rapidly, therefore, efficient and effective filtering and seismic feature extraction for the geologist and seismic data interpreters is needed. One of the most useful feature extraction algorithm is the coherence or edge detection algorithm. Edge-detection algorithms generally enhance and highlight subtle sub-surface geological features. These algorithms are, however, computationally expensive. Innovation to reduce the compute time for large seismic volumes is needed. Herein we present High Performance Computing (HPC) implementation of the 3D edge detection using the Sobel operator. Use of the 3D Sobel operator on seismic data was first published by Tertois and Frank in 2006 (Tertois and Frank, 2006). We have developed software incorporating the 3D Sobel operator in the HPC environment. It includes a Graphical Processing Unit (GPU) architecture, OpenMP, MPI and CUDA implementation. Some of the issues encountered, lessons learned and performance results were compared and documented. Although the implementation shown here is for the Sobel operator, HPC and GPU technologies can easily be extended to any other 3D seismic attribute. In our analysis for a 16 MB poststack seismic volume, the CUDA version of the algorithm was fastest among MPI and OpenMP. However, as the size of data increases MPI became the fastest reaching almost seven times serial version of the algorithm followed up by six times faster with CUDA and three times with OpenMP at a size of 250 MB. The faster performance allows us to generate and analyze seismic attributes volumes efficiently contributing to the well location optimization and drilling risk reduction