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Modernizing Geophysical HPC at Petrobras: Harpia in Focus

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Introduction

The increasing demand for high-resolution seismic processing, particularly in pre-salt seismic projects, has driven the continuous modernization of Petrobras' High Performance Computing (HPC) infrastructure. Since the 1960s, when the first Brazilian HPC infrastructure was established, the evolution of processing clusters has played a strategic role in supporting geophysical workflows, enabling faster turnaround and more accurate subsurface imaging.

Method and/or Theory

This work presents a historical overview of the HPC clusters used in geophysics at Petrobras, with a focus on the recent deployment of the Harpia cluster. Harpia is equipped with NVIDIA H100 GPUs and was benchmarked against its predecessor, the Pégaso cluster, which used A100 GPUs. Performance evaluation was based on TFLOPS metrics and benchmark tests using real seismic images and geophysical imaging algorithms, including RTM (Reverse Time Migration) and LSRTM (Least-Squares RTM), applied to both streamer and OBN (Ocean Bottom Node) datasets. These benchmarks were designed to reflect the computational demands of production-scale seismic imaging. The analysis also considers architectural differences between clusters, workload migration strategies, and user management practices.

Results and Conclusions

Benchmark results indicate that Harpia delivers up to 1.8x greater performance compared to Pégaso (for RTM algorithm), with significant improvements in processing efficiency and scalability. Operational impacts since Harpia's deployment include reduced job queue times and enhanced support for large-scale seismic workloads. The findings reinforce the strategic importance of HPC in accelerating exploration projects and supporting geoscientific decision-making.