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SeisBAi: A Brazilian AI Software Platform for Advanced Geophysical Analysis

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Introduction

SeisBAi is an innovative desktop application designed to revolutionize seismic data interpretation through integrated artificial intelligence (AI) capabilities. Developed in Python with a PyQt6 interface, this platform addresses critical challenges in geophysical analysis by combining traditional interpretation methods with cutting-edge machine learning algorithms. The system streamlines workflows for horizon interpolation, fault detection, and synthetic data generation, offering geoscientists a unified environment for seismic data visualization and analysis. By supporting standard formats like SEG-Y and NetCDF, SeisBAi bridges the gap between conventional interpretation techniques and modern AI-driven approaches, significantly enhancing efficiency and accuracy in hydrocarbon exploration.

Method and/or Theory

The software adopts a modular architecture with three core components: a data management system using SQLite for project organization, a high-performance visualization engine (VisPy) for 2D/3D rendering, and specialized AI modules for seismic interpretation. The framework processes seismic volumes through a pipeline that includes data normalization, feature extraction, and machine learning model integration. For horizon tracking, it employs convolutional neural networks (CNNs) to interpolate sparse interpretations into complete surfaces. The fault detection module utilizes patch-based CNN analysis with post-processing algorithms to refine fault planes. A synthetic data generator creates training datasets with configurable geological features and noise profiles. The system's interactive tools enable real-time quality control and iterative model refinement.

Results and Conclusions

SeisBAi delivers three key innovations: (1) an integrated workspace for AI-assisted seismic interpretation, reducing manual effort by up to 40% in benchmark tests; (2) standardized outputs including interpreted horizons, fault probability cubes, and synthetic datasets; and (3) a project-based workflow ensuring reproducibility and collaboration. The software maintains computational efficiency, handling volumes exceeding 1TB with optimized memory management. Field applications demonstrate improved consistency in horizon tracking and fault identification compared to manual methods. Future developments will expand the AI model library and integrate cloud-based collaboration features, positioning SeisBAi as a comprehensive solution for next-generation geophysical analysis.