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A Python-Based Tool for Generating Property Models from User-Defined Images

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Introduction

In seismic modeling and inversion studies, realistic subsurface models play a crucial role in testing algorithms and interpreting geophysical responses. This project provides a fast way to generate 2D acoustic and elastic property models from user-defined images, such as geological structures like salt bodies, fault structures, and complex geological scenarios. These visual representations are converted into geophysical models by assigning velocity and density values to distinct lithological regions, which can then be used in seismic simulations and inversion workflows.

Method and/or Theory

Using the Python programming language, algorithms were created to transform the image into grayscale and map each brightness value to a physical property defined by the user; however, for complex geological models, this task could prove more difficult when selecting each brightness, since the model would be composed of many colors. To solve this problem, a minimum and maximum interval is chosen and correctly interpolated. The user defines the physical properties, such as the wave velocities P and S, and density (ρ), through a parameter file located in the project folder. The program reads this text file, parses the image provided by the user, and replaces each RGB pixel value with its corresponding defined value. In the end, the outputs are binary files suitable for further use in seismic forward modeling or inversion workflows.

Results and Conclusions

The tool successfully converts images of complex geological structures images into property models. Tests using images representing salt bodies, fault systems, and layered sedimentary structures demonstrated that the algorithm accurately mapped lithological variations to user-defined physical parameters. The resulting 2D models preserve the spatial integrity of the input structures and are readily compatible with seismic modeling and inversion software. This approach enables rapid prototyping of geological scenarios and provides an efficient interface between visual geological interpretation and numerical geophysical simulation.