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3D GIS as an Integrated Framework for Drilling Site Location Optimization

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Abstract

Given a table of 30,000 coordinate pairs representing the geographic locations of potential sites for new wells to be drilled and a repository of lease, platform, pipeline, directional survey, production, and chronostratigraphic data spanning the Gulf of Mexico region, we demonstrate how a 3D GIS can be used as an integrating technology to facilitate determination of the optimal well location.

Previous studies have highlighted the user interface, data management, 2D analytical, and surface visualization capabilities of GIS technology as it applies to E&P workflows, but have not addressed the same technology's programmatic customization, 3D analytical, and subsurface visualization capabilities. This is due in part to the fact that the range of features and capabilities found in tools that ship with the GIS product are adequate for most GIS users' needs, and the justification to explore the software's programmatic capabilities is frequently unmet. Furthermore, 3D technology is relatively new, tools supporting visualization and analysis based on 3D technology are in limited availability, and 3D has traditionally been regarded as a non-vital feature of information visualization rather than a dimension of data upon which analytical processes can be improved.

Through custom code written that programmatically exercises the GIS software's engine via an API, we demonstrate how vector geometry representations of features can be persisted into a geospatial database, 3D computational geometry interfaces can be used to derive new vector datasets from this data, geostatistical interpolation techniques can be used to construct probability surfaces from these derivative datasets, and a set of optimal locations can be determined through an integrated analysis of this data. We discuss how the entire process can be automated to dynamically respond to changes in input data, the results of analyses can be visualized in 3D, and visual patterns found in data can be leveraged to correlate between fields on a regional scale and guide future exploration efforts.

This paper is significant in that it presents the 3D analytical capabilities of GIS software as it applies to E&P workflows, provides examples of customizations, and encourages exploration of 3D GIS as a technology for making better integrated decisions.

Introduction

A literature survey of papers published until June 2008 reveals that studies that have addressed the benefits of GIS for E&P workflows fall into one of four broad categories:

1. Environmental and Safety Benefits
2. Data Management and Integration Benefits
3. Surface Visualization Benefits
4. Data Mining and Feature Extraction Benefits

The vast majority of studies surveyed (Arthur, et al. 2003; Biniwale 2003; Daly, et al.; Franke 1996; Head et al. 2000; Jaggernaut 2003; Janks, et al. 1995; Lasrado 2008; Moreau et al. 1994; Shamsan and Kumar 2005; Skeie, et al. 2000; Sulistiyono, et al. 1998; Xavier, et al. 2008) illustrate the 2D analytical capabilities of GIS in the context of addressing