Machine Learning Establishes a Strong Foothold in Exploration and Development Geophysics

Evolving artificial intelligence applications promise benefits to geophysicists.

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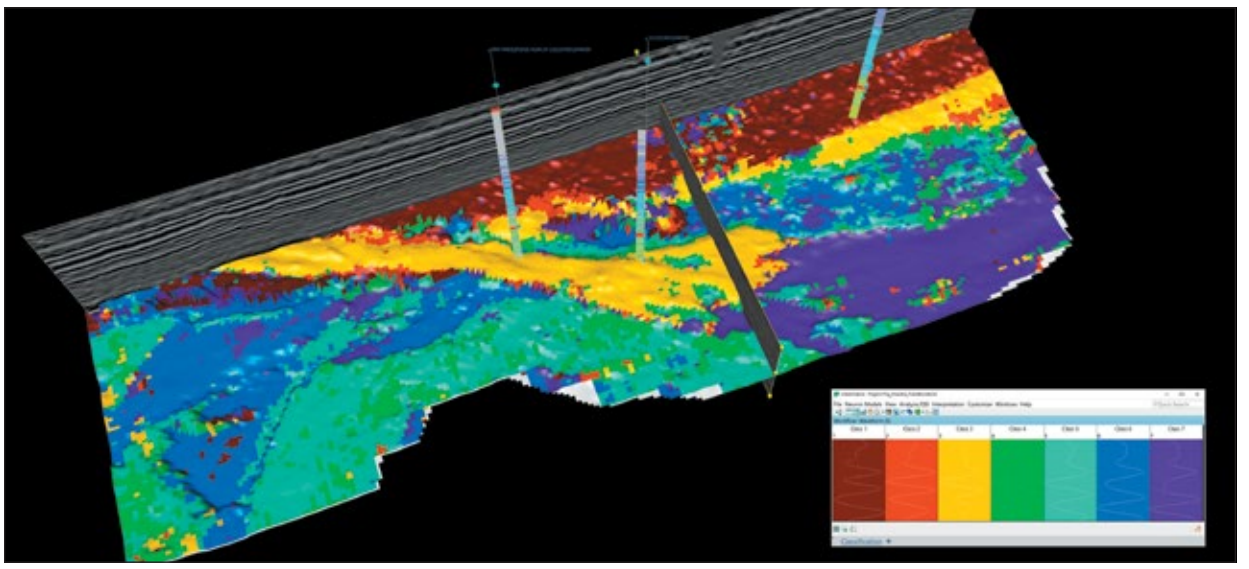

This waveform classification for seismic facies analysis uses an advanced artificial intelligence process that excels at pattern recognition. (Image courtesy of Emerson)

Machine learning technology is creating significant excitement in the oil and gas industry, with its promise of delivering new functionalities and workflows that will, among other things

- Automate repetitive, tedious and labor-intensive tasks and workflows;
- Extract key information from large amounts of multifactorial data;
- Capture uncertainty;
- Classify and transform digital subsurface data to more diagnostic deliverables; and
- Reduce cycle time, project costs and time to decision.

Machine learning is an application of artificial intelligence in which applications learn specific rules or tasks by themselves, without being explicitly programmed. It is particularly useful when working with large datasets as it detects patterns, makes predictions and may even recommend outcomes that may not be intuitively obvious to human observers.

Artificial Neural Networks (ANNs) are the machine learning technology used most in the oil and gas industry. Inspired by biological neural networks, ANNs can process large amounts of data and extract patterns and information that the human brain cannot see.

Emerson has a 25-year history of adapting and commercializing neural network technology to aid geoscientists in many ways, delivering a broad range of benefits over many disciplinary domains, from automation (first break picking, pioneered in 1991) to classification (electro facies, seismic facies and multiple seismic attributes) and transformation (well log prediction, AVA, 4-D equalization and offset cross equalization).

More recent advances in machine learning have resulted in a new generation of "decision-supporting" solutions, including self-growing and multi-input, multi-output neural networks (rock type prediction and classification), which can train neural network algorithms on input as diverse as prestack data and lithology logs, and provide users with qualified "most probable" seismic classification volumes.

While machine learning is most often used for classification tasks, the rapidly evolving field of deep learning is increasingly being applied to image analysis and object recognition. Encouraging results are being observed in the application of neural networks trained by experienced interpreters for the purposes of horizon, fault and geobody picking.

Deep learning is also showing huge promise in locating target subsurface features using the wavefields recorded and available in prestack seismic data. However, the identification of wavefields associated with targeted subsurface features cannot be solved with deep learning methods alone. A sophisticated data preparation must be run to allow the image capture of wavefields prior to the generation and application of deep learning filters. This problem is solved by using a full-azimuth prestack depth imaging procedure carried out in the local angle domain (EarthStudy 360) where full-azimuth direction angle gathers are created. Each directional angle gather consists of thousands of traces (directions) illuminating each subsurface point from a rich spectrum of angles. Deep learning filters can be designed to recognize all types of subsurface features (e.g., salts, reefs, channels, faults, diffractions) including those associated with low energy that are often missed in traditional seismic processing and imaging workflows.

The promise for the not-so-distant future is that all of these existing, evolving and new technologies, when combined in a chain of processes, will result in consistent, rapid, repeatable automation of mechanical day-to-day activities, providing processing geophysicists, geologists, interpreters, modelers and engineers with more time to focus on the all-important knowledge-based quantitative analysis (and intuition) that lies behind the development of new plays, with quantified uncertainty as a key component.

With a rich history of pioneering the application of machine learning technologies and with proven commercialized technologies and advanced platforms, Emerson continues to lead the way in the development and adoption of innovative technologies, which are rapidly changing our industry and, indeed, the entire world.

Most of these machine learning applications are available in commercial solutions and are being presented in this year's program at Emerson booth 1433. ■

Unlock Data's Potential

Latest data solution improves data access for better subsurface insights.

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Continuous improvements are being developed for a knowledge management system to unlock the potential of all subsurface intelligence. (Image courtesy of Ikon Science)

Ikon Science will be showcasing the latest developments in iPoint at this year's SEG. The newest member of an expansive technology portfolio, iPoint is a state-of-the-art data aggregation and knowledge management system that is used by large and small forward-thinking oil and gas companies to aggregate, cultivate and share knowledge between subsurface teams, managers and other key staff within an organization. As the emphasis in the industry shifts from production to long-term profitability, many companies are looking to gain more subsurface insights from their data and in order to do so, they must have easy and confident access to that data; that is the primary purpose of the iPoint solution.

Since acquiring the product and team, Ikon Science has begun transforming the iPoint solution from the wellbore to the full subsurface. iPoint 2019.3, released on Monday, Sept. 16, features new support and handling of absolute time-based data, which will open up capabilities for drilling, production and other key parts of the oil and gas lifecycle. In addition, the iPoint framework has been updated to handle seismic as a new data type, which will allow the development teams to expand with SEG-Y reading capabilities very quickly.

Ikon Science is also introducing direct two-way connectivity to Petrel, allowing users to easily transfer wellbore data between Petrel and the iPoint management platform, in addition to the existent and similar in-built connector for RokDoc.

Further improvements include a redesigned user-interface providing an improved user experience, in addition to the ongoing upgrades to the back-end architecture that promote ever-increasing flexibility, scalability and custom configuration for bulk data handling.

Outside of the core Ikon Science offering for the oil and gas industry, one of the most significant development highlights is a result of collaboration with Seequent, which has enabled a decline curve analysis tool in the iPoint package in addition to connectivity to and from Seequent's flagship product Leapfrog Geothermal. This allows data to be aggregated and easily accessed by geothermal scientists for critical workflows using Seequent's technology enabling digital transformation in other key industries focused on the subsurface.

To hear more more about iPoint visit Ikon Science booth 2829 to see a scheduled talk or arrange a personal demo. ■