USER STORY

GeoMechanics Cuts Product Development Costs by 50% Using MathWorks Tools

THE CHALLENGE

To enable oil companies to minimize wellbore instability and extract the maximum amount of oil from a well

THE SOLUTION

Use MathWorks tools to develop software that lets drilling engineers and geophysicists analyze key parameters and prevent wellbore failure

THE RESULTS

- Product development costs halved
- Quick response to customer requirements
- Millions of dollars of drilling costs saved

To extract the maximum amount of oil from reservoirs worldwide, oil companies are drilling more complicated, deeper wells in more hostile environments. When wells run tens of thousands of feet underground, it is difficult to maintain stability in the borehole wall. Industry analysts estimate that drilling problems resulting from wellbore instability cost oil companies approximately $6 billion a year.

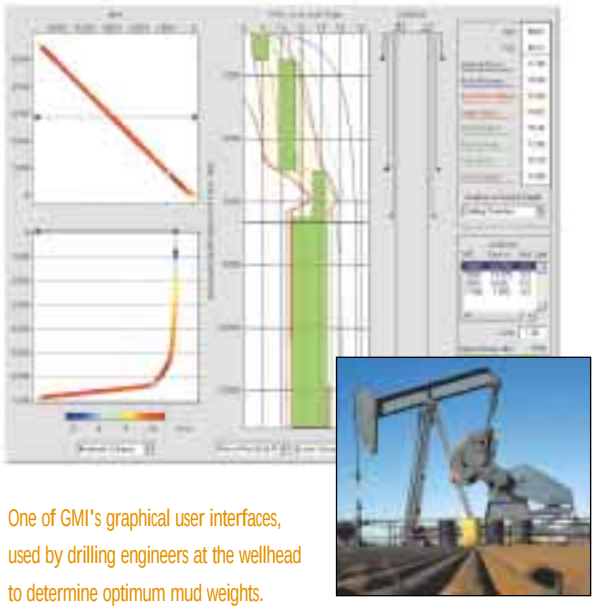
GeoMechanics International (GMI) has developed oil field tools that address wellbore instability problems. Among these is GMI • SFIB™ (Stress and Failure of Inclined Boreholes), a set of tools that enables engineers to evaluate how changes in wellbore trajectory, rock strength, and mud weight affect stability.

MathWorks software significantly reduces product development time and costs for GMI. "MATLAB® is, by far, the easiest programming environment for scientific use," says Dr. Daniel Moos, Senior Vice President of GMI's Technology Department. "It enables us to develop robust products in the shortest time possible."

THE CHALLENGE

GMI set out to develop a tool that would enable oil companies to improve drilling efficiency by correctly gauging the density of drilling mud needed to minimize wellbore instability.

Drilling mud is a mixture of fluids, weighting material, and chemicals used to flush rock cuttings out of the well while drilling. To ensure wellbore stability, the mud must be of the right density: If the mud weight is too low, the hole will enlarge, leading to excess cuttings and eventual hole collapse.



One of GMI's graphical user interfaces, used by drilling engineers at the wellhead to determine optimum mud weights.

If the mud weight is too high, it will fracture the formation, leading to losses of expensive drilling mud, reduced mud weight support, and possible hole collapse.

Gauging the correct density requires detailed understanding of the relationship between the stress field, natural fractures, rock strength, pore pressure, and borehole trajectories. Traditionally, oil companies use geophysical measurements and simplified models to develop mud weight recommendations.

Even in the best cases, standard approaches provide only a partial answer. GMI wanted to create a tool that would apply improved understanding of the causes of wellbore instability to enable more effective analyses. This tool had to be easy to use and make an inherently complicated problem straightforward enough for a drilling engineer to handle in the field.

> *Using MATLAB is the fastest and most efficient way to produce a quality product.*
>
> Dr. Daniel Moos,
> GeoMechanics International

THE SOLUTION

Using MATLAB, GMI built tools that perform rapid forward modeling and Monte Carlo simulations during drilling to assess risk and determine which variables have the most impact on reducing risk.

First, they developed a set of modules to constrain the complete stress tensor (the interplay of stresses in three dimensions during drilling). The input data to these modules included, for the first time, quantitative observations of failure in previously drilled wells where the drilling trajectory was known. They used MATLAB to test and find algorithms for determining which stress tensor was compatible with the observations and to design interactive GUIs for delivering interpretable results to the user.

A second set of program modules was developed to use this knowledge of stress to predict wellbore stability and find optimal drilling trajectories and mud weights. GMI used MATLAB to create a graphical interface to display the analysis results clearly and simply.

In the final stage, they used the MATLAB Runtime Server to turn the MATLAB code into a stand-alone application that could be used even by engineers who did not know MATLAB.

"The MATLAB Runtime Server enabled our development engineers to create the final product, removing one link in the development chain," says Moos. "It also provides a straightforward way to protect our products and is platform-independent in terms of our source code, which is critical for us."

THE RESULTS

- **Product development costs halved.** "MATLAB lets us act as designer and programmer," Moos explains. "It removes a bottleneck in the product development process where the designer has to hand off algorithms to a programmer for designing the interface. We've done comparisons between MATLAB and Java, and found that product development costs are as much as 50% less using MATLAB."
- **Quick response to customer requirements.** "MathWorks toolboxes give us the flexibility to add new functionality to our products," says Moos. "For example, we use the Statistics Toolbox to determine the influence of input parameter uncertainties on the output, based on Monte Carlo analyses for risk assessment. We then incorporate the resulting algorithms into our products. We would not be able to do this work without the Statistics Toolbox."
- **Millions of dollars of drilling costs saved.** More than 30 of the largest exploration and production companies save millions of dollars by using GMI's MATLAB based tools to prevent costly wellbore failures and maximize the amount of oil acquired from fields throughout the world.

To learn more about GeoMechanics International, visit **www.geomi.com**.

APPLICATION AREAS

- Earth and ocean sciences
- Petroleum/chemical
- Research and development

PRODUCTS USED

- MATLAB®
- MATLAB Runtime Server
- Statistics Toolbox

www.mathworks.com

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