A MINE OF DATA

Neville Judd, Hexagon Mining, presents an overview of software solutions for coal mine planning and optimisation.

When Atrum Coal needed to create a model of its Groundhog anthracite project in British Columbia, Canada, it turned to MineSight, the mine planning technologies software suite from Hexagon Mining. The Groundhog project covers 800 km^2 and represents the world's largest high-grade anthracite deposit.

"Our project is unique in the sense that it's a big area and it has small seams, which are close together," explains Atrum Coal Senior Geologist, Raza Parvez. "It has partings in them and so we are constantly updating our model."

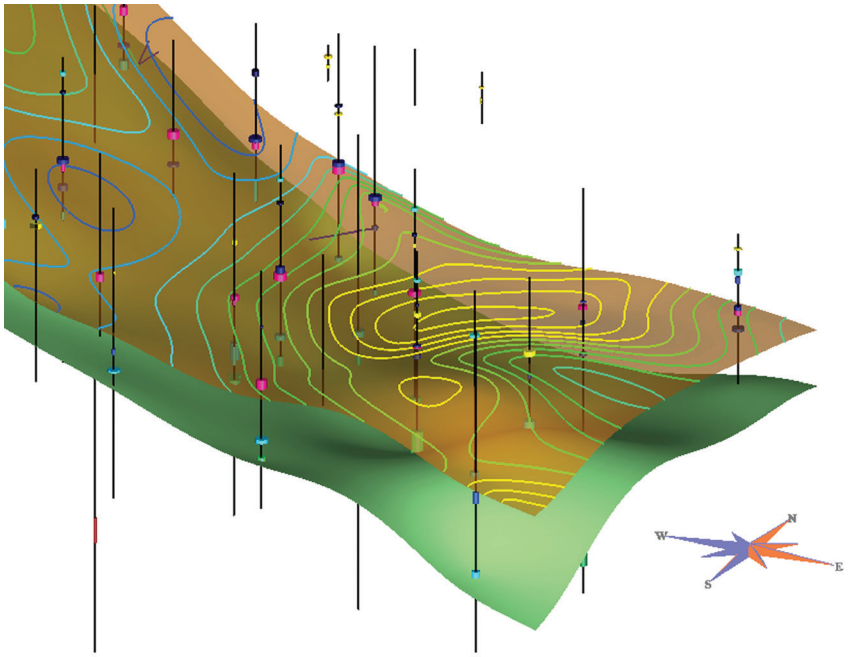
The MineSight Implicit Modeler proved to be invaluable. Parvez explains: "The traditional way of doing footwalls and then doing sections and then creating surfaces would have taken so long. And so with Implicit Modeler, we just update those points and then we get in our drillhole database and we get a new surface very quickly."

The Implicit Modeler is one of several MineSight products for modelling and reporting coal. Hexagon Mining also offers coal-friendly products via its mine safety technologies suite, SAFEmine, and its mine operation technologies suite – Jigsaw (surface) and SmartMine UG (underground).

MineSight Implicit Modeler allows geologists to rapidly build models and grade shells directly from drillholes. It avoids the need to manually create and link sectional interpretations, and it masters complicated surfaces.

Dustin Meisburger, Senior Mining Engineer at Anglo American's Peace River Coal in northern British Columbia, considers some of the benefits of the software: "I think MineSight Implicit Modeler is really going to revolutionise how complex coal models are built.

"You're not going to have to digitise 200, 300 sections. You'll let Implicit Modeler build your surfaces and you'll still do the work; you'll look at the drillhole data and if you've got to make changes you'll make changes, but to have that initial amount of work done before you start is huge."

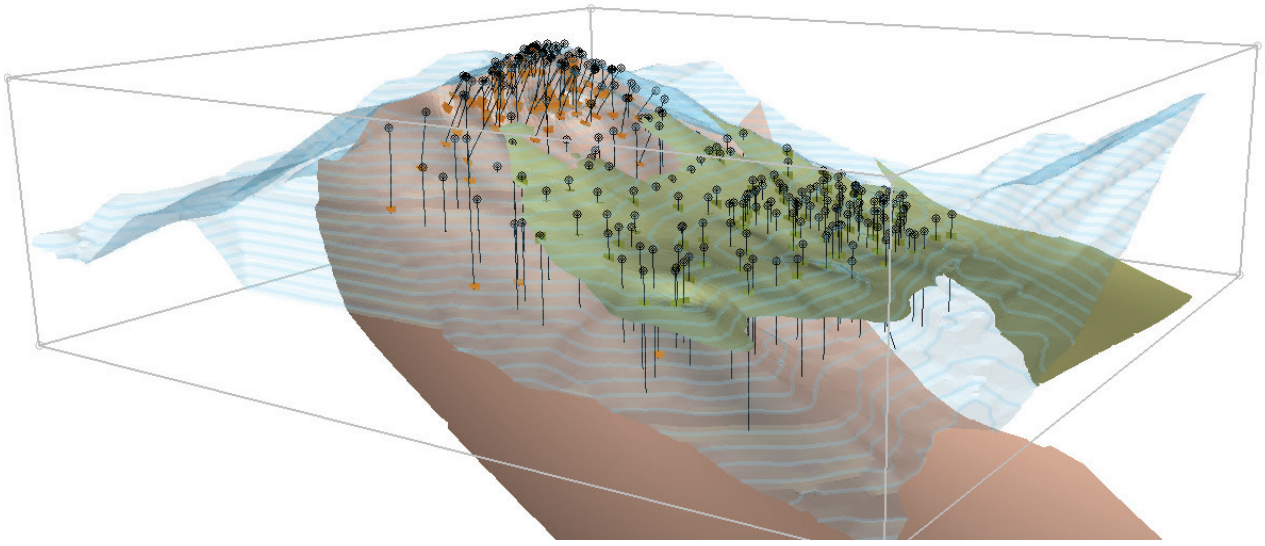


Combining MSIM and MSTorque: drillholes through a coal seam model.

Implicit modelling

Implicit modelling is a mathematical surface fitting method that interpolates points on the surface to give a smoother fit. MineSight Implicit Modeler uses the Radial Basis Function algorithm, which has been performance-tuned and can achieve the following:

- Create surfaces or solids from drillholes.
- Build overturned and complex seam surfaces directly from drillholes, which is useful for complex coal.
- Link polygons that have been defined explicitly and deal with splits, joins, bifurcations, etc.
- Create surfaces from explicit polylines.
- Use a combination of drillhole and polygon/polyline/point input for surfaces and solids.



MSIM: Generation of seam surfaces directly from drillholes (great for complex coal modelling).

- Solid or surface created in the MineSight Implicit Modeler can be coded straight to a 3DBM without any import/export.

Recent improvements to MineSight Implicit Modeler further simplify coal modelling. These include the addition of true thickness logic, dual contouring for complex surfaces, closed solids and the ability to use an edit grid to define the plane of anisotropy.

True thickness logic is important when building seam type surfaces from drillhole data where there is a need to interpolate the location of the top surface from the bottom surface. This is common in coal modelling. The challenge facing geologists is that the downhole or measured thickness is an apparent thickness, not the true seam thickness.

MineSight Implicit Modeler addresses that challenge. It can calculate the true thickness and use that information to build other surfaces, e.g. the hanging wall from the footwall.

Software solutions

In many parts of the world, coal mines face unprecedented challenges. Stringent legislation governing production and emissions means companies demand unique software solutions.

MineSight addresses these challenges by offering advantages for modelling and reporting coal, particularly structurally complex coal. It can handle both metallurgical and thermal coal deposits, as well as reporting and modelling multiple coal types within each of these deposits.

For block models, MineSight is able to model unlimited seams in one project. With greater spatial precision, sub-blocking enhances MineSight's underground solution and makes modelling even the narrowest coal seams quick and simple. It is also the only software package with fully integrated haulage and multiple equipment allocation.

MineSight supports the following types of block models:

SAFEmine FatigueMonitor.

SAFEmine FatigueMonitor in 3D.

- Multiple ore percent for unequalled accuracy in complex geology.
- Gridded seam models for stratiform deposits.
- Sub-blocked models for spatial precision.

MineSight Reserve, which unifies the consolidated power of MineSight's reserve engines, provides complex coal functionality and comprehensive reporting logic. New multiple ore percent support in MineSight Data Analyst, as well as enhancements in MineSight Torque that improve complex coal modelling, create a complete package. MineSight Schedule Optimizer is equipped with new features, such as multiple equipment sets by material for handling different waste types and coal seams.

"MineSight's got a very long history in the coal business and one of the primary drivers of the Teck Coal usage has been the development over the last 25 years of the geological modelling component," says Eric Jensen, Director of Engineering at Canadian company, Teck Coal.

Mine safety technology

Teck Coal also uses SAFEmine, Hexagon Mining's mine safety technologies, for collision avoidance solutions. Ease of use and

functionality were key components in Teck's search for a technology standard for vehicle safety across all of its operations in 2012. In its request for proposals, the company evaluated available technologies and suppliers that could be implemented across its portfolio.

For SAFEmine, this meant delivering a solution that supported – not replaced – Teck's existing safety procedures. Other considerations were to minimise operator overload and nuisance alarms. It demonstrated the effectiveness of its collision avoidance system (CAS) to increase operator awareness, as well as online real-time tracking of vehicles and vehicle status, which allowed remote collection of data. Alarms associated with speeding, close vehicle interactions and potential collisions were analysed. Another section of the programme analysed customised alarming scheme performance on the specific interactions being examined.

SAFEmine's CAS system components comprise the following four parts:

- A GPS/RF antenna, which houses both the GPS antenna and the RF antenna for the vehicle-to-vehicle radio network.
- A main unit with a GPS receiver, processor and onboard memory (black box-type recording).
- A remote display with LED indicators to show the location of nearby vehicles and to generate audible collision alarms when two or more vehicles are on a collision course.
- A Wi-Fi antenna for connection to SAFEmine's TRACK server for real-time tracking and monitoring of equipment.

Following a detailed evaluation process, Teck chose SAFEmine as its preferred solution for reducing or eliminating contact incidents between heavy mining equipment and light vehicles.

"SAFEmine was selected based on its ability to not only detect the proximity of vehicles, but also when they were on a potential collision course and deliver this information to equipment operators via an intuitive user interface," said Teck Mining Technology Principal Advisor, Peter Wan. "The ability to quickly install systems in visitor vehicles was also a significant benefit."

SAFEmine solutions are used worldwide, delivering collision avoidance and fatigue monitoring systems in coal mines from Colombia to Australia.

Fatigue detection

In opencast mines, approximately 65% of truck haulage accidents are directly related to driver fatigue or exhaustion. To address the issue, SAFEmine introduced FatigueMonitor, which integrates data from fatigue detection and collision avoidance units to minimise accidents involving mining vehicles.

Simple to use, the FatigueMonitor helps operators maintain levels of attention that are required during mining operations, while providing management with driver fatigue profiles and traffic-related data. Based on scientific research carried out by the University of Zurich and the Hospital of Berne, the system uses intelligent fatigue assessment algorithms to estimate driver fatigue levels and predict fatigue development. The black-box recording technology, which includes a video, provides a reliable tool for analysing incidents. The design also allows for the operator to work without using additional equipment, such as caps or glasses.

By closely monitoring vehicle movements, operator fatigue and operator distraction, traffic safety in the opencast mine can be significantly enhanced. FatigueMonitor accomplishes this by integrating data from multiple inputs: attention-level detection (camera vision), body clock (circadian rhythms) and individual traffic behaviour (from the collision avoidance system).

Via SAFEmine, Hexagon Mining offers an array of products and services that include collision avoidance systems, real-time fleet tracking, fatigue monitoring, systems to protect clean-up equipment around heavy rotating machines and displays that integrate vital safety information intuitively in cabins.

Fleet management

Coal producers also utilise Jigsaw, Hexagon Mining's mine operations technology, for fleet management solutions. Coal India (CIL) has installed a GPS-based movement tracking system to increase output in its major mines.

CIL has approximately 400 mines and 30 000 heavy-duty mining vehicles. A study conducted by CIL showed that a 170 t truck sitting idle for 30 min. cost the company US$800. This cost doubled for a 240 t truck. With project assistance from Hexagon Mining, CIL is addressing potential losses with a GPS-based coal handling and mining vehicle tracking system.

Hexagon Mining is connecting coal mines underground with its SmartMine UG product. SmartMine UG is a comprehensive system that manages underground mine processes. Launched in late 2014, SmartMine UG respects underground essentials, such as process control logic, data communication challenges, safety standards, environmental issues, and other factors.

Conclusion

While still a relatively new company, Hexagon Mining's combined product suites represent more than 100 years of expertise. By cultivating the exciting synergies between those product suites, the company will integrate design, planning and operations technologies for a life of mine solution. The culmination of some of those synergies will be seen later this year when Hexagon Mining introduces HxM Athena, its business intelligence/business analytics tool, and its drill-and-blast utility, HxM Blast.

By helping the industry transform its data into knowledge, Hexagon Mining aims to be the dependable foundation on which mines can build safer, more productive futures. WC