case study.

Major mining OEM confirms performance of the AMT Guidance System on a Rotor Borer Mining Machine.

Driven by advanced automation goals, an international OEM mining machine supplier invited Applied Mining Technologies to demonstrate and evaluate the performance of AMT's MGS (Mining Guidance System) technology in guiding their underground mining machine.

challenge.

Keeping a large production mining machine on track is difficult, typically requiring breaks in production for setting up lasers and manual surveying of the machine track and calculation of directional adjustments. The resources and production downtime involved is inefficient and expensive and underground mining operations across numerous commodities are seeking autonomous navigation solutions that deliver sustained accuracy and reduce or eliminate the need to stop.

A large OEM approached Applied Mining Technologies to demonstrate its widely used Mining Guidance System (MGS) on a rotor borer mining machine at their European underground soft-rock operations. The goal was to evaluate the reliability and accuracy of the MGS to provide enabling automation technology for safer and more consistent productivity.

This case study details the results of a three-month trial of AMT's guidance technology under full production underground mining conditions.

solution.

After a detailed design and planning phase, AMT senior engineers worked with the mining equipment OEM to install and commission the Mining Guidance System on their large rotor borer mining machine with its associated conveyor system.

Although the MGS provides for closed-loop steering control, the trial was conducted with the MGS in an open-loop monitoring and data recording mode. The installed system consisted of an AMT MGS Controller unit in combination with a high-performance Inertial Navigation Sensor (INS) mounted on the mining machine. An AMT 3D Optical Tracker was mounted on the rear underside of the machine to aid the inertial motion tracking.

As part of the test plan, an independent professional survey of the mining machine was conducted at the beginning and end of the trial and at two intermediate locations to provide ground truth 3D position reference points. This allowed for an extensive test and evaluation of AMT's technology under full production mining conditions.

The survey data was entered via the MGS web-based user interface to provide corrections to the MGS-computed navigation algorithms. The complete navigation data set was analysed at the completion of the trial to determine the MGS accuracy throughout the 3-month trial against the survey reference data.

results.

In addition to demonstrating the robustness and reliability of the AMT technology the primary goal of the trial was to quantify the amount of 'track error' or drift, both vertically and horizontally, that develops over distance. This drift is measured as the difference between the MGS-measured track and the independent survey measurements and is best represented as a percentage of distance travelled.

The MGS-recorded data with survey corrections is shown below with the MGS measured path of the miner (light green) and the corrected MGS measured path (dark green). Note that the x-axis displays the full 1,164m of travel whereas the y-axis is in centimetres.

From these results the average track error for the test (as a percentage of distance travelled) was 0.02% in Cross Track (horizontal drift) and 0.1% in Vertical Track.

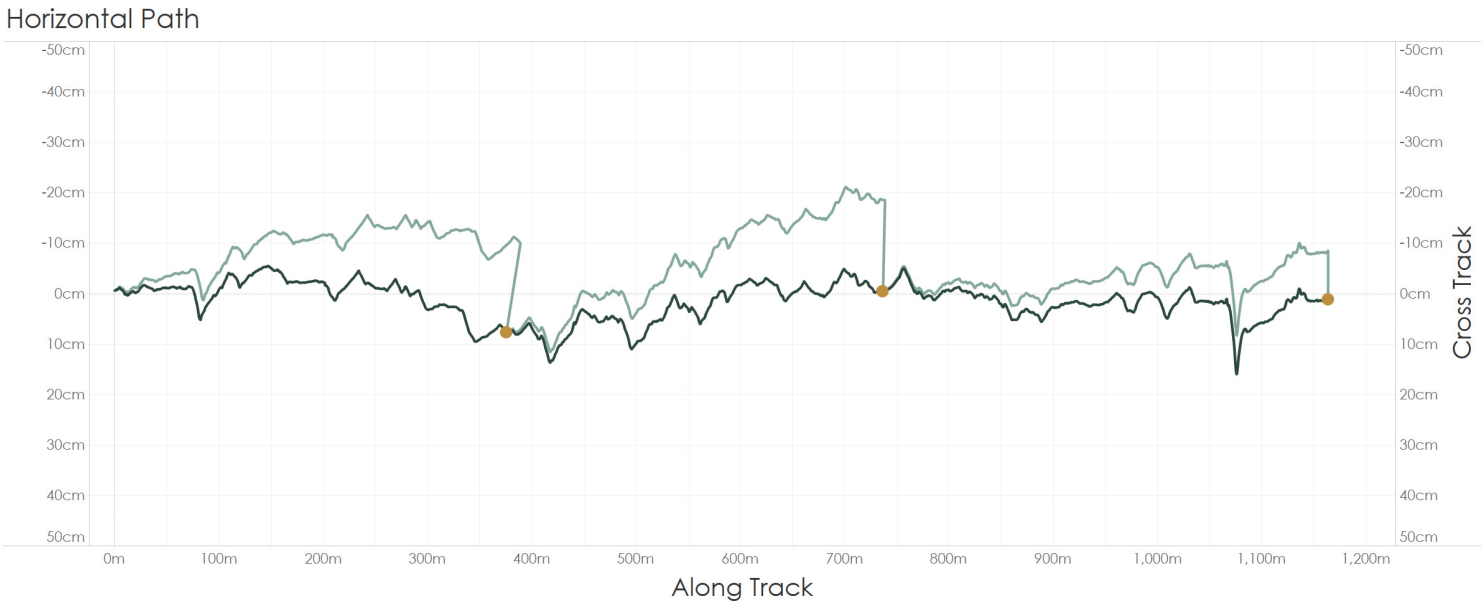

Figure 1: The mining path as measured by the MGS and survey points - before corrections (light green) and after survey corrections applied (dark green)

The independently verified measurements taken at survey points 1, 2, and 3 show the largest deviations being just 11.0cm horizontally and 60.1cm vertically at these points. The details of these path error measurements are tabled below:

Survey	Distance Since Correction	Error		As Percentage of Distance Travelled	
		Cross Track	Vertical Track	Cross Track	Vertical Track
1	375.6m	-1.0cm	60.1cm	0.003%	0.160%
2	361.1m	10.3cm	-20.3cm	0.028%	-0.056%
3	426.8m	-11.0cm	-44.3cm	-0.026%	-0.104%
Mean Magnitude:		**7.4cm**	**41.5cm**	**0.019%**	**0.107%**

Table 1: A summary of the MGS performance throughout the trial as determined from the ground truth manual surveys which were also used to fully optimise the navigation solution.

conclusion.

Automation in underground mining operations is a major driver in the pursuit of safer operations, higher yields and lower production costs.

The three-month underground trial of the AMT Mining Guidance System in a full production underground soft-rock mining operation was conclusive in demonstrating the reliability, accuracy and general applicability of this technology for advanced underground mining operations.

> The MGS technology from AMT works amazingly well in underground GPS denied mining environments. The profiles of the rooms cut automatically using the MGS are straighter and smoother than what could possibly be achieved by the best and most experienced operators. I would highly recommend incorporating it into any mining automation project.

AN EXISTING MAJOR UNDERGROUND MINING CUSTOMER

About MGS by Applied Mining Technologies

Based in Queensland, Australia, AMT has developed its Mining Guidance System to provide integrated and comprehensive navigation sensing and tracking for underground mining operations. MGS helps to solve the automation challenges that underground operations face, leading to safer and more controlled mining and increased production output.

For a detailed discussion about how MGS technology can be used to boost productivity at your site, please talk with us today on +61 7 3201 2663 or email info@appliedmining.tech.

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