AI Based Geophysical System for the Estimation of Iron Ore Grade in a Truck

Master Geotech Services Pvt Ltd and Cojag Smart Technologies Pvt Ltd have jointly developed a unique Artificial Intelligence based tool for estimating the grade of iron ore in a truck. The tool uses information from four geophysical sensors which are in contact with the ore within the truck and provides the grade classification within 3-7 minutes while the truck is being weighed at the weighbridge. The grade and weight of the iron ore can be printed on the same challan.

Problem Definition

The classification of iron ore is based on the percentage of iron in the ore and different grades of iron are sold at different rates. Accurate determination of the grade of the iron ore is therefore of importance to both the buyer and the seller of the ore. Iron ore can be priced at about Rs 1,421 per ton of ore with grade less than 55% Fe to about Rs 8,718 per ton of ore with grade more than 65% Fe and each 30-ton truck can thus be valued at between Rs 42,630 and Rs 2,61,540 depending on the grade of the ore. Incorrect classification of the ore can thus hurt the buyer of the ore (if the actual grade is lower than estimated) or the seller of the ore (if the actual grade is higher than estimated). Since the government royalties and payments are also based on the correct estimation of the grade of the iron ore in the truck, the payments to the government can also be affected by incorrect classification of the iron ore. With daily dispatches of iron ore running into 500,000 tons, a misclassification of one level of iron ore grade can result in a value error of Rs 50 crores.

Data from weighbridges

All mines require a strong and reliable weighing system for revenue management, cost control, operating efficiency, and regulatory compliance. Weighbridges use cutting-edge technology to deliver precise and accurate weight data. With more precise weight data, the mines have a better control on the inventory, obtain and record precise measurements of incoming and outgoing materials, and reduce onsite waste. Weighbridges are available in a variety of sizes and capabilities, and can be mounted at ground level, above ground, or in the ground. Various accessories, such as boom gates, remote displays, and traffic control

lights, are available from different vendors and they give legal-for-trade weight readings allowing the mines to keep track of the weight data for regulatory and reporting needs. However, the current weighbridges do not have any system to track the grade of ore in the truck (Figure 1).

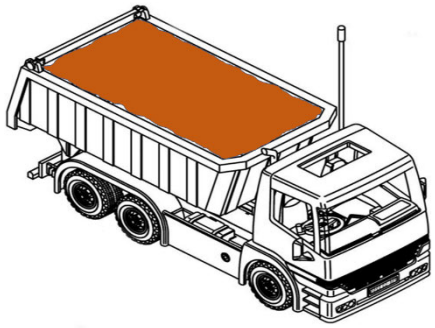

Figure 1: Loaded truck at weighbridge

Estimation of iron ore grade in a truck using AI powered geophysical system

Master Geotech Services Pvt Ltd (MGS) and Cojag Smart Technologies Pvt Ltd (Cojag) have collaborated to create an AI powered system to estimate the grade of iron ore in a truck using geophysical sensors. The system is designed to be simple and easy to install at existing weighbridges. The data from four geophysical sensors will be collected at the weighbridge and the system will process the data and calculate the average grade of iron ore inside the truck body within 3-7 minutes, while the truck is waiting at the weighbridge. All four sensors are required to touch the surface of the material in the truck for the data to be generated (Figure 2).

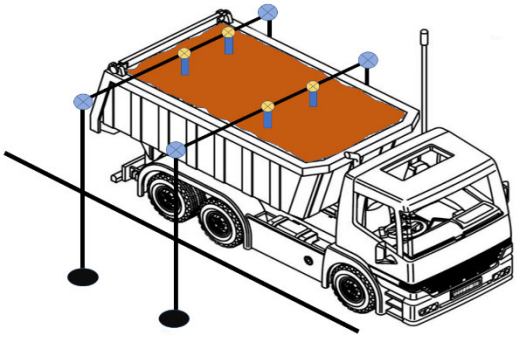

Figure 2: Loaded truck with geophysical sensor array (in blue) at weighbridge.

Large variations in the volume and grade of iron ore within the ground are quite common and estimation methods, such as the integral method and the method of parallel sections, generate an average grade for the material within a specified volume. Using the same analogy for the ore within the closed surface system of a truck body, a new geophysical procedure has been developed to assess the grade of the ore carried in the truck, using the body of the truck as the basement. For solving this problem, the procedure developed by Cojag calculates the overall grade in the truck using the volume of the material in the truck with different average grades assigned to different zones within the truck body. An average grade for the ore within the truck is then calculated.

The perimeter projection method and triangulation for mixed ore body contours are used to develop a three-dimensional model of the ore within the truck. The model is then subdivided into a group of parallel sections and a grade is assigned to each section. When the distance between parallel planes approaches zero, the sum of thin slices volumes is approximately equal to the true volume, because the irregular shaped volume is replaced by a regular volume with the traditional methods. Integration of the grades and volumes of the parallel sections creates an accurate calculation of volume and grade of the material within the truck. The calculated convergence speed of the ore grade block volume is observed to be dependent on the distance between the thin slices. If the distance between the thin slices reduces gradually, the calculated result converges gradually.

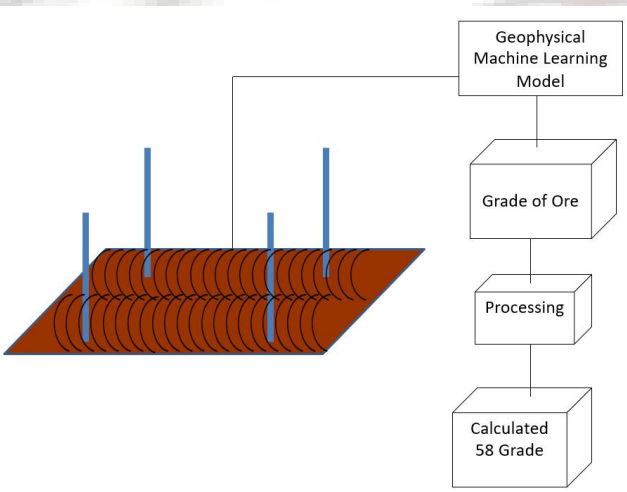

Figure 3: General process of calculation of volume and average grade of iron ore in loaded truck

Testing the Concept

Three-dimensional geophysical inversion modeling of sensor data has been performed to test the validity of a 3D model constructed for the volume of material in a truck. Geophysical modeling was implemented in three different ways:

- fully unconstrained (i.e., no geologic data included),
- constrained by the 3D geologic model using homogeneous rock unit densities, and
- constrained by the 3D geologic model using heterogeneous rock unit densities.

We have proved that the 3D model developed using the sensor data can accurately calculate the average grade of iron-ore. The evaluation suggests that field testing of the concept using different grades of iron ore would improve the correlation between the observed sensor data and the calculated sensor response.

References

www.cojagtech.com
www.mgstucson.com

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