Deep Learning - A New Paradigm for Orebody Modelling

S. Sullivan[1], C. Green[2], D. Carter[3], H. Sanderson[4] and J. Batchelor[5]

1. Product Manager, Machine Learning, Maptek Pty Ltd, Adelaide SA 5065 steve.sullivan@maptek.com.au
2. Leader of Strategic Innovation, Maptek Pty Ltd, Perth WA 6003 chris.green@maptek.com.au
3. Data Scientist, Maptek Pty Ltd, Perth WA 6003 derek.carter@maptek.com.au
4. Principal, CYENCY, Perth WA 6000 hugh@cyency.com
5. Principal Digital Orebody, Roy Hill Iron Ore Pty Ltd, WA 6015 james.batchelor@royhill.com.au

ABSTRACT

A key input to any concept, study, plan or budget is the geological or resource model. Conventionally these models require a great deal of subjective manual interpretation and estimation using whichever method generates the least error. The end to end process, depending on the size of the model and the scale and complexity of the variables, can take several months which is a drain on company resources and provides no tactical benefit or agility.

Models should provide the best emulation of geological processes and physical observations, and irrespective of methodology should be dependable and defendable. If this can be achieved rapidly with a measure of uncertainty then the opportunities to streamline business processes, reduce costs and make faster smarter uncertainty-based decisions will be realised.

The rise of computer-based modelling served to move orebody interpretation away from 1D paper to a 2.5D digital form, and for many years this method excelled above all others but at its core, its accuracy has always been subject to the skills, efficiency and subjectivity of the operator. More recently semi-automatic methods such as simulation of categorical variables and implicit modelling have become increasingly popular, but these methods also have limitations such as processing time and scalability.

The derivation of a measure of uncertainty around an estimate or model requires the application of an appropriate simulation method, which in itself takes too long to form part of any tactical process and is more often than not isolated to long term strategic planning.

The many disruptive technologies introduced by Industry 4.0 bring with them some exciting opportunities to streamline business processes, reduce costs and make faster smarter uncertainty-based decisions. As miners look to maintain a competitive advantage, healthy margins and effectively navigate technical and operational challenges in an agile manner. In what can be a volatile industry, the need to embrace digital transformation is becoming ever more important.

This paper introduces a new neural net deep learning approach that can rapidly (in a matter of minutes or hours) generate classified/domained orebody models, including the estimation of multiple numeric variables and uncertainties, directly from spatially referenced pre-coded sample data. This is the future of orebody modelling.

A case study is presented that demonstrates the application of the new deep learning method to the Roy Hill Iron Ore deposit in Western Australia along with a brief comparative analysis against a conventional resource estimate generated using ordinary kriging.