A Novel Physics-AI based Hybrid Digital Twin for Enhanced Gold Recovery

Satyan Bhongale[1] *and Pamela Moyo*[2]

1. Chief Analytics Advisor, 654 Research Inc., San Ramon, CA 94583, USA. sbhongale@gmail.com
2. Senior Metallurgical Engineer, Barrick Gold, Elko, NV 89801, USA. pmoyo@barrick.com

ABSTRACT

Digital Twin (DT) is a model that allow for making predictions about a certain industrial process with the model parameters representing the control variables. The fidelity of the DT ultimately is defined by the accuracy with which it can predict the desired target variable. However, the precise nature of the DT can range anywhere between an exact differential equation as in a controlled laboratory setting to a completely data-driven Artificial Intelligence (AI) model in the presence of several uncontrolled variables and non-equilibrium processes. The reality is always somewhere in between due to operational difficulties of maintaining precise value of a few control variables arising from a combination of: unknown ore composition, lack of sensors and/or poor sensor quality, variable measurement intervals, non-equilibrium processes, and uncontrolled environmental conditions.

Here, we present a novel Physics-AI based hybrid DT (HDT) of a CIL based Gold processing plant. The HDT is able to model the complete end-to-end operation from the point the ore leaves the stockpile to the point tailings are expelled from the final stage of the CIL/CIC circuit. The HDT was build using real-life data from Barrick's Cortez plant. The prediction fidelity of the HDT as quantified by the statistical r-squared statistical measure was found to be in the vicinity of 0.9. While such high r-squared values have never been achieved before, the HDT clearly opens a new avenue allowing for real time AI based dynamic control of e.g. Cyanide dosing to control the CIL cyanide tails. This ensures enough cyanide in the circuit to minimize recovery loss, while simultaneously saving cost from overdosing. Overdosing leads to use of expensive reagents to treat CIL cyanide tails in order to meet the required environmental permit levels.

Keywords: Digital Twin, Artificial Intelligence, Machine Learning, Gold Processing, CIL