HDR Topic 1

Principal Supervisor: Professor David Lancaster

Title: Mineral and metal identification through the correlation of elemental, mineralogical and hyperspectral sensor data.

Background

This project forms part of the Research Consortia Programme for *Unlocking Complex Resources Through Lean Processing*, funded by the South Australia Premier's Research and Industry Fund.

The research programme includes 12 industrial company collaborators and 16 academics from mining engineering, mineral processing, computer science, electrical and electronic engineering, mechanical engineering, and chemical engineering.

This is a unique opportunity for the successful applicant to work in this inter-disciplinary academic and industry environment together with other PhD students and post-doctoral researchers.

Project description and objectives

The successful applicant will work in the general topic area of spectroscopic sensor data from analytical instrumentation developed by industry collaborators within the Research Consortia Programme. The overall aim being to push the limits of individual and combined sensor information in identifying and quantifying key commodity metals and minerals in the mining and minerals processing context.

Key objectives will include:

(1) Examine and evaluate existing elemental and mineral sensing technologies, and their combinations for metal and mineral identification.
(2) Use of individual and combined sensors to detect and quantify key ore characteristics affecting ore variability to the mill and thresholds for processing strategy.
(3) Develop data analytics methodology to combine sensor data to deliver robust ore characteristics information to inform process control and decision making.

Sensing tools and instrumentation that will be considered are Prompt Gamma Neutron Activation Analysis (PGNAA), Near Infra-Red (NIR) and Infra-Red (IR) spectroscopy and reflectometry, Magnetic Resonance (MR) techniques and X-ray Transmission (XRT), and other commercially-available sensing equipment.

Ore characteristics of high priority include, but are not limited to, Cu, Au and U grade, S content, Cu mineral type/ratio, etc. Short data acquisition times, equivalent to 20 tonnes (belt) average, are required to be relevant to plant throughput levels.

Outcomes will be used to signpost opportunities in other stages of the overall Consortium effort focussed on belt, drill sensing and resource fingerprinting identification studies, in collaboration with Post-Doctoral Research Fellows and Senior Researchers in the team.

Project methodology

The project will be carried out in collaboration with the following companies: Mine Vision Systems, Scantech and Boart Longyear. The collaborating companies will provide support and access to their specific software tools and sensor suites. The candidate will be trained on the use of specific platforms and data analysis tools, necessary for their work.

It is expected that the successful candidate will spend considerable time at the collaborating company site and at locations where sensor data will be collected. The latter may include time at drilling facilities or mine sites and processing plants.

Skills and background knowledge required of the PhD candidate

The successful applicant will have a good understanding of compositional and structural analysis of geological materials. Knowledge of data analysis and computer literacy are essential.

Applicants should hold an Honours or Masters degree preferably in a physical or earth science, with a significant research component, preferably with some spectroscopy content. Equivalent international qualifications will be considered.

Project milestones and deliverables

Note that this is a preliminary statement and, as with all PhD projects, the direction may change as ideas are developed and new data become available. The successful applicant, in consultation with his/her supervisors, will be required to produce his/her own research proposal which would include a detailed set of project milestones. Specific milestones and deliverables, which will be detailed in the candidate's Research Proposal. These will include:

(1) Literature review and preliminary assessment of sensing technologies.
(2) Submit research proposal.
(3) Collection and analysis of data taken with various sensor technologies on rock, stockpile belt samples and cores.
(4) Examination of the data collected, and development methods of combining/correlating these data to arrive at measures of ore attributes relevant to ore variability and processing.
(5) Identify key limitations and opportunities for sensor and sensor combination development.

The candidate will work closely with the collaborating companies throughout their candidature, and industry representatives will be formal members of the student's supervisory panel.

Other milestones include formal annual reviews of progress under the University of South Australia procedures, the expectation that at least two papers will be written and submitted for publication in appropriate journals, and the writing and submission of a thesis.

Regular reports are expected during the course of the overall program, along with presentations at workshops and review meetings.

References

Duffy, K.A., Valery, W., Jankovic, A., Holtham, P. and Valle R. (2015) In search of the holy grail – bulk ore sorting. Metso Austmine 2015 White paper.

Lim, C.S. and Sowerby, B.D., On-line bulk elemental analysis in the resource industries using neutron-gamma techniques, J. Radioanalytical and Nuclear Chemistry, 264(1), 15-19 (2005)

Balzan, L., Jolly, T., Harris, A. and Bauk, Z., Greater use of Geoscan on-belt analysis for process control at Sepon Copper Operation, Mill Operators' Conference 10th October 2016.

Link to presentation

Muller, H. and Kurth, H., Innovation in on-belt analysis technology Link to web article