Through the Melbourne Mining Integrator (MMI), the University of Melbourne works with explorers, miners and mining equipment, technology and service (METS) providers to tackle some of the sector’s most challenging problems.

The MMI assembles multidisciplinary teams from across the University to leverage our extensive knowledge of the mining industry, integrating new perspectives and different approaches more commonly applied in other industries such as defence, manufacturing, finance and IT.

Our considerable expertise in machine learning and artificial intelligence, data analytics, social trends, environmental management, logistics and financial assessment are already being applied within the mining industry.

Working closely with our partners, we can provide end-to-end solutions – from shaping technological problems, analysing the solutions through simulation, through to testing prototypes in our facilities and in the field.

Through the MMI we are uniquely positioned to provide an integrated view of the mining value chain and also harness the unique capabilities across Australia’s most successful universities.

THREE KEY PROGRAMS OF RESEARCH

» Next generation digital mining – new techniques to analyse the large volumes of exploration and mine data to optimise mine operation and maximise value

» Mine planning and agile logistics – new techniques and mine designs to optimise operations along mining supply chains incorporating real-time responsiveness

» Process productivity – improving the performance of existing unit operations and developing new systems incorporating latest technologies
This research program aims to develop and deploy new techniques for analysing the large volumes of data that will be produced in the future and use this analysis to improve mine operations. Mine sites are increasingly moving to remote and autonomous operation with remote sensing, robotics and autonomous infrastructure. In this setting, more data will be available than ever, from the increased monitoring of a material’s characteristics as it moves from pit to plant and real-time knowledge of the location and status of equipment and stockpiled ore.

Next generation digital mining techniques have the capacity to:

» facilitate reconciliation between expected and realised outcomes;

» communicate the overall state, and predicted future state, of operations to miners in real time, given large volumes of data from varying sources; and

» continually revise ore body models in terms of composition and processing characteristics as new data arises.

This research program is guided by expertise in data mining, machine learning, simulation and modelling, remote sensing, stream data mining, decision analytics and real options analysis.

The mining industry is awash with data from many sources, from exploration, mining and mobile and fixed equipment through to complex process control systems. The challenge is to use this data to make informed decisions that enhance safety and maximise value.

**CASE STUDY**

**Thickener process control**

MMI has developed a new approach that allows plant operators to put more trust in a wide range of unit controllers in ore processing and separation plants, such as for thickeners. It combines expertise in physical and chemical processing models with control theory and machine learning to great effect.

Statistical machine learning is used to estimate the parameters of controllers, based on self-learning that optimises both unit operations and across the system. Artificial intelligence techniques are used for failure detection and improving the set points across different operating regimes and shifts. This aims to improve the trust of the operators in the virtual plant and controller, resulting in a more strategic, proactive and consistent operating environment to better meet production objectives.

**OUR RESEARCH TEAM**

**Dr Ben Rubinstein**

**Research Team Leader**

Ben joined the University of Melbourne in 2013 as a senior lecturer in computing and information systems. He brings research experience from Microsoft, Google, Intel and Yahoo! in the US and IBM Research-Australia. He pursues research in machine learning, security, privacy and databases.

**Professor James Bailey**

» Data and decision analytics

» Statistical machine learning and data integration

**Professor Rui Zhang**

» Data analytics for value

**Professor Antoinette Tordesillas**

» Mechanics of granular media and complex systems

» Data analytics
**Life-of-mine (LOM) planning for the Pilbara iron ore network**

MMI has developed life-of-mine (LOM) planning techniques for an open-pit iron ore mine network in Western Australia’s Pilbara region. New, more efficient and scalable algorithms developed for a tier-one miner are delivering a step change in the speed of options made available to mine planners, solving LOM planning problems much faster than previously possible. The approach helps optimise multiple objectives and decisions on stockpiling, practical mining constraints and financial modelling for capital expenditure. The techniques also help to free millions of dollars in cash flow and ensure an even-greater net present value over the life of the mine.
PROCESS PRODUCTIVITY

The mining industry is constantly being challenged to improve safety and increase the productivity of its assets, while simultaneously aiming to maintain or improve product quality.

This research program aims to optimise the productivity of current assets and also develop and deploy new technologies for the extraction of metals from their ores. Advanced processing techniques have the potential to significantly improve the efficiency of mining operations. The use of column arrangements, for example, in place of mixer-settlers in solvent extraction processes can reduce capital costs and land and operational requirements, while increasing plant throughput.

Improved chemicals and models that describe chemical interactions with target metals can improve plant efficiency and metal yields while potentially reducing water and energy requirements, significantly reducing operating costs and the environmental footprint of an operation.

The MMI has expertise in advanced polymers, flocculation, solid-liquid separation, rheology control and flotation, sludge thickening and dewatering, and advanced equipment and solvents for solvent extraction processes. We also work in energy-efficient comminution solutions and mineral recovery through flotation.

CASE STUDY

Solvent extraction
MMI has developed advanced techniques for the extraction of metals from their ores based on the use of pulsed columns – a game-changing alternative to mixer-settlers. Our advanced chemical and thermodynamic models have improved plant efficiency and metal yields while dramatically reducing water and energy requirements. After demonstrating a prototype based on pulsed columns, the technique has been successfully scaled up and deployed at a major mine site, halving water use.

CASE STUDY

Minerals processing
The university has developed novel techniques in minerals processing using polymeric reagents in solid/liquid separation and froth flotation. Key outcomes include demonstrating that underflow density can be increased while reducing rheological (flow) properties to reduce pumping energy to tailings dams. This work has led to improved grade and recovery of fine iron and copper ores in flotation.

OUR RESEARCH TEAM

Dr Kathryn Mumford
Research Team Leader
Kathryn is a senior lecturer in the Department of Chemical and Biomolecular Engineering at the University of Melbourne whose research has delivered breakthroughs in separations processes, specifically ion exchange, solvent absorption and solvent extraction technologies.

Professor Peter Scales
» Particulate fluids processing
» Wastewater processing
» Rheology (used in ore processing) and flocculation

Dr Anthony Stickland
» Solid-liquid separation
» Suspension rheology

Professor George Franks
» Mineral processing, flocculation and colloids
» Surface chemistry
» Mining reagents and flotation

Dr Iman Shames
» Control theory and systems

PARTNER AND COLLABORATE WITH US

From complex multi-partner research to short consulting projects, find out how your business can engage with the University of Melbourne.

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