Automated Characterisation of the Dump Materials

S. Thiruchittampalam[1], B. P. Banerjee[2], N. F. Glenn[3], S. Raval[4]

1.PhD candidate, School of Minerals and Energy Resources Engineering, University of New South Wales, Sydney, NSW, 2052. Australia. Email: s.thiruchittampalam@unsw.edu.au
2.Lecturer, School of Surveying and Built Environment, University of Southern Queensland, Toowoomba, QLD 4350, Australia. Email: bikram.banerjee@unisq.edu.au
3.Professor, Department of Geosciences, Boise State University, Boise, ID, USA. Email: nancyglenn@boisestate.edu
4.Associate Professor, School of Minerals and Energy Resources Engineering, University of New South Wales, Sydney, NSW, 2052. Email: simit@unsw.edu.au

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ABSTRACT

Shear strength of the spoil is the most critical parameter that influences waste dump stability. Determining the shear strength parameters of spoil traditionally involves time-consuming laboratory tests. Therefore, Simmons and McManus (2004) developed a “CoalSpoil” framework that serves as the basis for classifying spoils with different shear strength parameters based on their visual-tactile attributes for coal mines. However, this characterisation process could be made more consistent by minimising human interventions to avoid biases, classification errors, and exposure to safety hazards. Therefore, an alternative method is needed that involves remote digital data capture and automated data analytics in the dump material characterisation process. Image analysis techniques have been identified as a potential complementary approach to field investigations, aiming to enhance the consistency of the current spoil characterisation process.

In this work, we utilised drone images acquired over coal mine dumps from seven coal mine sites in Australia along with nearly 700 ground validation samples. Through the analysis conducted, we unearthed the immense potential for automating spoil characterisation. To achieve this, we employed multiple machine learning algorithms to delve into spectral, textural, and contextual information extracted from drone images, enabling geotechnical characterisation at both pixel and object levels.

The drone-based spoil characterisation workflow witnessed a significant boost in performance by incorporating thermal and multispectral data sourced from a multispectral sensor. We also explored potential of a close-range imaging captured from a portable handheld device. Advanced transfer learning methods were able to achieve material characterisation accuracy of over 90%. In summary, this study highlights the potential of automated spoil characterisation, marking a transformative step towards improving waste dump stability.