**Tackling Geotechnical Risks in Open Pit Mining Using High-Resolution Uav Imaging and Advanced Image Processing**

Recent technological developments in remote sensing and image analysis and their introduction into the mining industry have opened the door for updating risk analysis techniques. The R&D team of the Mining Automation lab of the University of Nevada, Reno develops UAV-based photogrammetry and image analysis technologies to address the geotechnical risks of open-pit mining. All procedures are based on the high-resolution imaging by a special UAV control software for terrain-following of the open pits surfaces and use photogrammetry for 3D modeling. It can efficiently cover large areas and RGB cameras and thermal sensors can acquire high-resolution images as input for novel image analysis methods. As mapping of the rock mass has been unsafe, and costly practice an automated approach has been developed to extract visual features of the rock mass using a deep learning methodology. The biggest challenge in this approach is to have enough annotated samples to train a model that will output high-accuracy results in various rock types and environmental conditions such as weather and ambient light. The results can be used for localized risk analysis of rockfall using available empirical models. Convolutional Neural Network has been successfully used for the detection and monitoring of tension cracks and tailings dam overflow rills. Currently, the team works on the inclusion of multispectral imaging and bringing the whole development under a digital twin framework. The project studies the moisture content of the dam surface for early detection of any seepage signs as a simple and cost-effective dam monitoring technology. Continuous data flow from all project activities is critical for practically using a combination of physics-based and data-driven models. Mining sites are dynamic environments, and changes happen daily; therefore, the information about the rock surface must be updated at timely and financially efficient intervals. To combine all studies' results in a single environment, a geotechnical digital twin (gDT) of the mine site is investigated. The gDT would use a high-fidelity 3D model of the site enriched with semantic data received from monitoring, lab tests, and simulations to present necessary information in a unified interface for interactive decision making and developing a geotechnical risk map.