LITHOLOGICAL CLASSIFICATION USING UAV IMAGERY AND MACHINE LEARNING TECHNIQUES ON AND OPEN PIT MINE

Filipe, F.S. 1, Rodrigues, A.L. 2, Kloeckner, J. 3, Peroni, R.L. 4, Costa, J.F.C.L. 5

1, 2, 3, 4 Federal University of Rio Grande do Sul

ABSTRACT: Lithological classification and a subsequent efficient mine planning depend directly on the identification and precision of the geological features and geometry distribution of the contacts between different materials, such as waste and ore. The geological knowledge is a crucial factor from the early stages of the exploration, with the identification of the orebodies in local and regional scales, until the mine closure for any extraction process. During the life of an open cast mine, the geological model updating is meant to be a constant task to be executed, especially with information from the mining front. The constant geological mapping on the mine benches might be a slow and tedious job for the current days. Also, the professionals can be exposed to risks such as weather conditions, dust, gases, moving equipment and high altitudes. This process can benefit from automated detection of the limits between materials with sufficiently different visual features. Automated data classification, which is a reality fetched by the Machine Learning techniques with potential uses in mineral classification. With the sophistication and miniaturization of the unmanned aerial vehicles (“UAVs”) and their onboard sensors, several applications are being developed as the costs reduce, the battery life increases, and the computer processing improves. These benefits can also be implemented in the mining industry with low costs aircrafts and the solutions revealed as reliable. The automated classification on images is already a reality implemented on facial recognition or agriculture detection, for instance. However, the mining industry works with high relevance for all the three dimensions in space and the selection of samples is not a trivial task. The data considered to be classified is in digital elevation model built from information acquired by “UAVs” imagery. Through photogrammetry software, the images are converted into 3-D point clouds, representing the topographic shapes of the open pit mine with color information for each single point. A Python script has been developed to classify the three-dimensional point cloud, based on a sparser cloud, which represents centers and orientation of samples in space. To classify a quarry in southern Brazil, several Machine Learning algorithms have been tested, as well as their settings and fine tuning. The results presented by the model Support Vector Machine with RBF kernel show that over 98% of the classification is accurate, based on the input training data.

KEYWORDS: AUTOMATIC CLASSIFICATION, OPEN PIT MINE, UAV