Identification of the oversized material in hydraulic hammer crushing process based on 3D data analysis

Przemysław Dąbek¹ | Paulina Kujawa¹ | Adam Wróblewski¹

¹ Wydział Geoinżynierii, Górnicza i Geologii, Politechnika Wrocławska, Na Grobli 15, 50-421 Wrocław

Oversized material

Both open-pit and underground mining operations encounter the problem of large rock pieces left after blasting process. Rock breakers are utilized to reduce the size of this material so it can be suitable for subsequent crushing and conveyor systems [1]. Its importance can be explained, among others, by high energy-consumption (Figure 1). Identification of the oversized particles is one of the fundamental steps for analysis, optimization and automation of the process.

![Figure 1: The typical breakdown of energy costs in an average-size mining enterprise (a), and average energy consumption share in the creation, delivery of asphalt plant (b) ](image)

Measurement site

The data presented were obtained at KGHM Polkowice-Sieroszowice mine. A Livox Horizon laser scanner was used for the measurements, and the data collection was carried out from a single station. The scanning accuracy of this sensor for a single point is about 2 cm.

![Figure 2. View on the hydraulic hammer crushing station](image)

Screen under the hydraulic hammer, that is used during the crushing process, has defined window shape: in case of presented measurements, a square with a side of 0.4m size.

![Figure 3. View on the screen](image)

Proposed methodology

Proposed methodology for oversized rock (Figure 4) classification is based on the analysis of point cloud obtained from the laser scanner (Figure 5). After segmentation of a part of the data describing the rock, in this case manually, two farthest points are found (Figure 6). If distance calculated between them is larger than set threshold (based on the shape of window screen), data is processed further. Otherwise, the rock is classified as not-oversized.

Next step consist of creating a plane perpendicular to the line based on the previously found points. Then, every point in the data is projected onto created plane (Figure 7). This way, geometry calculated over projected points is directly interconnected with distance measured in the first step.

Lastly, a new pair of farthest points is found in the projected data and distance between them is calculated (Figure 8). Once again, if obtained value is larger than set threshold, rock is classified as oversized.

![Figure 4. Example image of the oversized rock](image)

![Figure 5. Farthest points from the measurement](image)

![Figure 6. Projection of points onto plane perpendicular to created line](image)

![Figure 7. Visualization of distance between two farthest points in the projected data](image)

References


Acknowledgements

This activity received funding from the European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation. This work was supported by EET RawMaterials GmbH under Framework Partnership Agreement No. 21056 (ECHO: Electrical Computerised Hammering Operator). The project is co-financed by the Polish Ministry of Education and Science within the framework of the program titled International Co-­Financed Projects.