Creating structured meshes of mining excavations based on variability trends of real point clouds from laser scanning

Jacek Wodecki[1*], Paulina Kujawa[1], Adam Wróblewski[1], Bartłomiej Ziętek[1]

[1] *Faculty of Geoengineering, Mining and Geology, Wrocław University of Science and Technology, Na Grobli 15, 50-421 Wrocław*

Corresponding author: jacek.wodecki@pwr.edu.pl

Keywords: laser scanning; SLAM; point clouds; synthetic models

Accurate modeling of airflows is an ongoing challenge for the scientific community. Various technologies are used to acquire and process 3D data of mining excavations, such as Terrestrial Laser Scanning (TLS), photogrammetry, or Mobile Mapping Systems (MMS) supported by Simultaneous Localization and Mapping (SLAM) algorithms. Due to often difficult measurement conditions, the data obtained is often incomplete or inaccurate. There are holes in the point cloud due to objects obscuring the tunnel. The data processing itself is also time-consuming. The point cloud needs to be cleaned of noise and unnecessary elements. The creation of a mesh model, which could then be subjected to further numerical calculations, is problematic in such a case. This paper proposes to create a synthetic model based on real data. 3D data of underground mining tunnels captured by a LiDAR sensor are processed employing feature extraction. A uniformly-sampled tunnel of given dimensions, point cloud resolution, and cross-section shape is created for which obtained features are applied, e.g. general trajectory of the tunnel, shapes of walls, and additional noise useful for obtaining surfaces of desired roughness. This allows to adjust the parameters like resolution, dimensions, or strengths of features to obtain the best possible representation of a real underground mining excavations geometry. From a perspective of Computational Fluid Dynamics (CFD) simulations of the airflow, this approach has the potential to shorten domains geometry preparation, increase the quality of computational meshes, reduces computational time, and increase the accuracy of results obtained, which is of a particular matter considering airflow modeling of extensive underground ventilation networks.