Improving dust management in gateroad development A CFD-VR based training tool for mine workforce

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ABSTRACT

Long term exposure to dust particles, in particular respirable dust, continues to present a occupational health and safety hazard to mine workers in underground coal mines. Workers who are exposed to coal dust can develop occupational lung diseases including coal workers pneumoconiosis (CWP) or 'black lung'.This paper introduces the development of an immersive simulation tool for dust and ventilation flow dynamics to demonstrate the exposure impact of working conditions and dust mitigation practices in longwall development panels.

Dust monitoring was undertaken in a development panel on three shifts at a mine site, using both real-time and static dust monitors. These dust monitoring data was then used with other site-specific information for CFD simulations and modelling results validation and calibration. Three-dimensional (3D) CFD models were developed to conduct transient simulations of ventilation and respirable dust flow patterns based on mining conditions and dust monitoring data. A novel method was to convert and filter the data into a suitable form that could be transferred and loaded on a portable Meta Quest 2 VR headset for interactively visualising dust data. Simulation data were sampled in such a way that they can be imported and rendered in the VR environment. The CFD-VR system has been validated in the form of independent assessments and via a series of industry showcases. These industry showcases enable stakeholders to gain a better understanding of dust and ventilation behaviour in various development operations and cutting scenarios and provide feedback on the developed intuitive VR training tool. W

The project has successfully developed a robust methodology integrating several advanced modelling and computational technologies for a VR visualisation and educational tool that can more intuitively and comprehensively communicate the results of CFD simulation data to mine workforce for health and safety training.