

Development of an Automated Roof Bolting Machine for Underground Coal Mines

This study describes and discusses the steps taken towards the development of an automated roof bolter that performs the roof bolting operation in underground mining environments. Roof bolting operations in underground mining expose human operators to a number of risks. Successful completion of bolting tasks depends heavily on operator judgment, fatigue, and experience to perform these tasks. During bolt installation, the operators are exposed to a potentially unstable roof, cumbersome consumables, and heavy spinning masses that could lead to fatal or serious injuries. The accident record motivates the development of automated roof bolting machines that removes humans from this process. The primary function of the operator would be to supervise all the operational tasks and to control the automated roof bolting via a human-computer interface (HCI) and intercede where necessary. The automated roof bolter performs a sequential bolting operation which includes drilling, drill steels removal, resin placement, and bolt installation. A six-axis robotic arm was integrated into the system to replace tasks performed by humans during the bolting operation. The robotic arm mimics and improves human tasks which in turn enhances productivity. Some novel technologies were developed with respect to the components that form the automated roof bolter such as the plate feeder, the bolter feeder, and the wrench. Other components such as the robotic arm controller, the programmable logic controller (PLC), the HCI, the drill control unit (DCU), and the hydraulic roof bolter are integrated through the process of 'handshake'. Integration of all components and technologies enables the proper sequencing of roof bolter operations. The study shows that the robotic arm can successfully perform human activities during roof bolting operations. More importantly, the operator can supervise the bolting process via a remote control