

**Grant:** AFC618-13

**Title:** Using Wearable IMUs to Evaluate Musculoskeletal Disorder Risk in Underground Mining Activities

**Organization:** South Dakota School of Mines and Technology

**Principal Investigator:** Adam K. Piper and Lance A. Roberts

**Focus Area:** Musculoskeletal Disorders

**Project Summary:**

The goal of this project is to address the important problem of musculoskeletal disorders in underground mining by characterizing the risk factors across multiple techniques and equipment types for common mining activities such as jackleg drilling, operating a mechanical rock-bolter, placing wire mesh for ground control, scaling loose rock along the back and ribs of a drift, operating a LHD vehicle, etc. In particular, the feasibility of capturing human motion via inertial measurement units (IMUs) in a well-defined underground mining environment will be investigated. By comparing the postures, forces and joint moments associated with various mining activities, an improved understanding of the specific physical demands of each task will permit better task allocation and job rotation for mining workers. Additionally, the comparison of two methods of performing the same task, jackleg operation versus rock bolter operation, will help evaluate the effectiveness of the newer technology for reducing the risk of MSDs in underground mining. Finally, if the use of IMUs in a real underground mining environment proves feasible, it could mean a shift in the paradigm of how ergonomics and physical job demands are assessed in the mining industry in the future for all types of underground mining activities.

The objectives of the study are listed below, with specific aims defined for each objective.

**Objective:** To characterize the MSD risk factors associated with force and posture during several real-world mining operations performed in an underground mining environment.

**Specific Aim 1:** Measure the joint angles and body segments of using 17 IMU sensors placed on the operator during jackleg drilling, during operation of a rock-bolter manufactured by the J.H. Fletcher & Company, mucking activities, placing wire mesh to provide ground support, and barring down and scaling activities. A biomechanical profile will be developed for each task that includes accounting of severe postures and estimates of joint moments and body segment loading.

**Objective:** Evaluate the effectiveness of replacing jackleg drilling with the use of a Fletcher Rock Bolter in reducing the risk factors for MSD development.

**Specific Aim 2:** Once biomechanical profiles are determined in Specific Aim #1 for jackleg drilling and operation of the rock bolter, statistical comparisons will be made for each joint and body segment to determine posture and moment/force differences between these two drilling techniques. An evaluation of the differences in MSD risk will be made by comparison to ergonomics guidelines associated with awkward postures and high forces/moments for physically demanding occupational activities.