

THE FUTURE FOR AUTOMATION

Manufacturing industries have for a long time been obtaining the key benefits of automation, these benefits are now becoming available to the mining industry. The key issues leading to the development of automated systems are safety and economic improvement. Safety is addressed by the removal of human operators from areas of high risk while economic improvement occurs with improvements in quality, quantity and reduced cost per unit of production.

For mining, automation will lead to improved mine safety with fewer people in hazardous areas and improved cost performance with improved utilisation of equipment, improved consistency of operation and higher productivities from equivalently sized equipment. These improvements will flow through to reduced injury rates, improved productivity and cost performance, and through to potential increases in ore reserves as a result of lower cut-off grades.

Automation





automation

CSIRO'S ROLE IN MINING AUTOMATION

CSIRO Mining Robotics is an important part of the development of mining automation. It has developed and utilised the skills required for this role through its part in the successful completion of a number of automation projects including the automated LHD, coal dragline swing and high-wall mining. New projects, as part of the vision for the future, are targeted in the business plans of Mining Robotics and are part of its focus on the future of mining. These projects cover the range from ones targeted at automating existing equipment through those targeted at creating new equipment to match existing mining techniques to those targeted at redesigning the mining systems to take advantage of modern and future technology.



ROBOTICS
AUTOMATION

Automation is the control of a process through a number of successive stages, generally by the use of electronic or mechanical devices to replace human labour. Automation in mining uses robots, machines designed to function in place of a living agent, carrying out a variety of tasks automatically or with a minimum of external control. These robots are not the androids (resembling a human being) of science fiction, but the integration of sensors and control systems onto existing and new mining equipment to enable a machine to perform a particular task or tasks without continuous human control.

Mining robots are different from the robots used in manufacturing processes, where components are conveyed to the robot assembled and the product conveyed away from the robot. In mining the robot needs to move to and around the work area to perform its task, they are still in every sense robots. Examples of robotics applied to mining developed by CSIRO are automated LHDs and automated draglines swings. CSIRO has played a leading role in the development of mining robotics and will continue to do so.

Autonomous machines need sensors to locate and orientate themselves, monitor the environment in which they are operating, to monitor the progress of their activity and monitor their condition. CSIRO has developed expertise in a wide range of sensing technologies and their application to mining.



sensing

This expertise covers inertial navigation systems, used in highwall mining to accurately locate the coal cutting operation. It includes the use of stereo-vision in photogrammetry for analysing rock jointing and pit imaging. Scanning laser range finders have been utilised for both the location and control of a LHD moving through underground drives as well as for determining the load contained in haul trucks.

Work is being undertaken in the area of 3D visualisation that will allow the results of this sensing to be presented for the monitoring and supervision of automated equipment from remote control rooms.



navigation

Navigation can be either absolute, where every object is defined within a co-ordinate system, or relative where the automated equipment will continually relocate itself relative to nearby objects.

CSIRO has successfully developed navigation and guidance technology for a wide variety of mining equipment as part of the process of automating mining systems. In underground coal CSIRO has developed systems for guiding coal cutting equipment within the coal seam. This system determines the cutters location in absolute terms to ensure that the design pillar dimensions are maintain while maximising coal recovery. Currently work is being undertaken on systems to enable full 3D navigation control of the long-wall mining process and on automated roof bolting systems.

In hard rock mining CSIRO developed the navigation system for the autonomous LHD. This is a relative system using a imud map to describe the path of the LHD and then utilising onboard sensors that imapi the drive geometry to continuously update the loaders location relative to walls, corners, draw points and dump points.

Navigation is the science of determining the position, orientation and course of a piece of equipment and directing the subsequent movement of that equipment in a logical manner to enable the equipment to perform its task. It is a skill, often taken for granted, that is essential for automated equipment that moves around the work area so that collisions with other objects can



system integration

Successful automation is more than just replacing humans with control systems to operate machines.

It involves redesign aspects of both machines and processes to gain the full benefit of automation. This redesign must take into account the environment in which the machine operates and the expectations of people involved in the process

Developing an automated machine and system requires skills in many areas including mechanical, electrical and electronic engineering as well as computing and communications.

It also requires practical experience with mine operations to ensure requirements for robustness, intrinsic safety, maintenance and operations acceptance can be carefully thought through.

communication

Recent mine emergency incidents have highlighted the requirement for personnel location monitoring and in response a system that can support escape and rescue in underground coal mines has been developed.

The Location and Monitoring for Personal Safety (LAMPS), a generic technology, features vital signs detection, radio tags, a survivable wireless radio beacon network, and a monitoring system.

To achieve maximum integration into existing underground environments the system allows for a subset to be incorporated into an existing mine communications systems and the tags will be included into the design of cap-lamp battery covers. Compatibility with existing computer platforms and databases are also important features of LAMPS. Future applications of LAMPS may include vehicle tracking and sensor monitoring at a variety of strategic locations.



CSIRO



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Contacts:
Queensland Centre for
Advanced Technologies
Technology Court
Pullenvale Qld 4069

PO Box 883
Kenmore Qld 4069

Telephone:
3327 4444

Facsimile:
3327 4455

Email:
advancedroboticmining@csiro.au

Website:
<http://www.qcat.csiro.au>