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Advances in Mineral Exploration and Mining Drilling Technologies

~ SMEDGE 11 September 2009,
Jock Cunningham

National Research FLAGSHIPS

CSIRO

Threat & opportunity drive mining technology

Decline in “easy” resources , change in environmental expectations, one or two trail blazers willing to take the risk. ~2015s

→ New mining methods based on robotics.

Acceptance: staff, management, investors Willing to change ~ 2010s

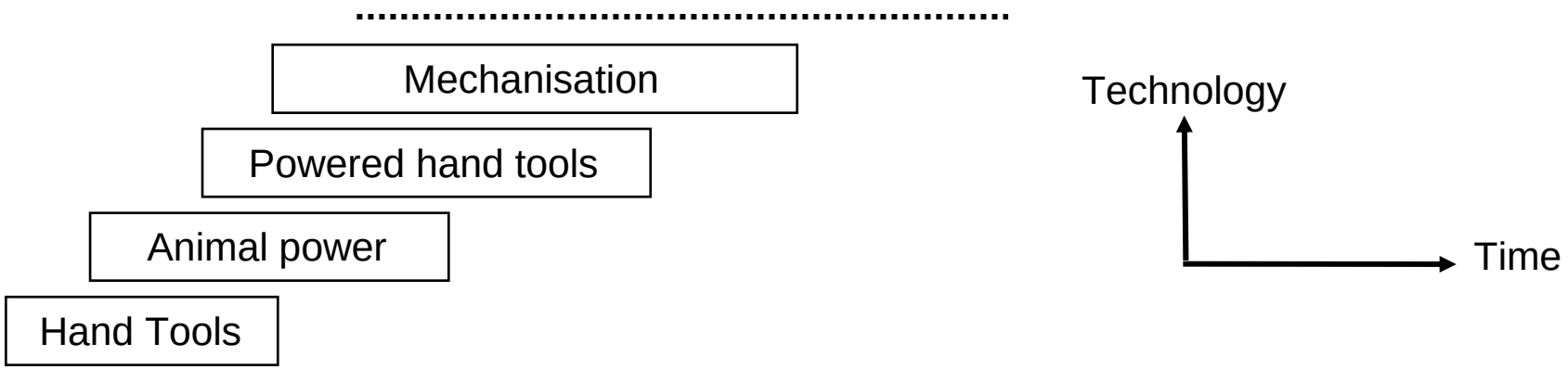
→ New concept machines built for automated environments.

Rugged computers , navigation instruments, wide-band communications (WiFi) ~ 1990s’

→ Existing machines are automated

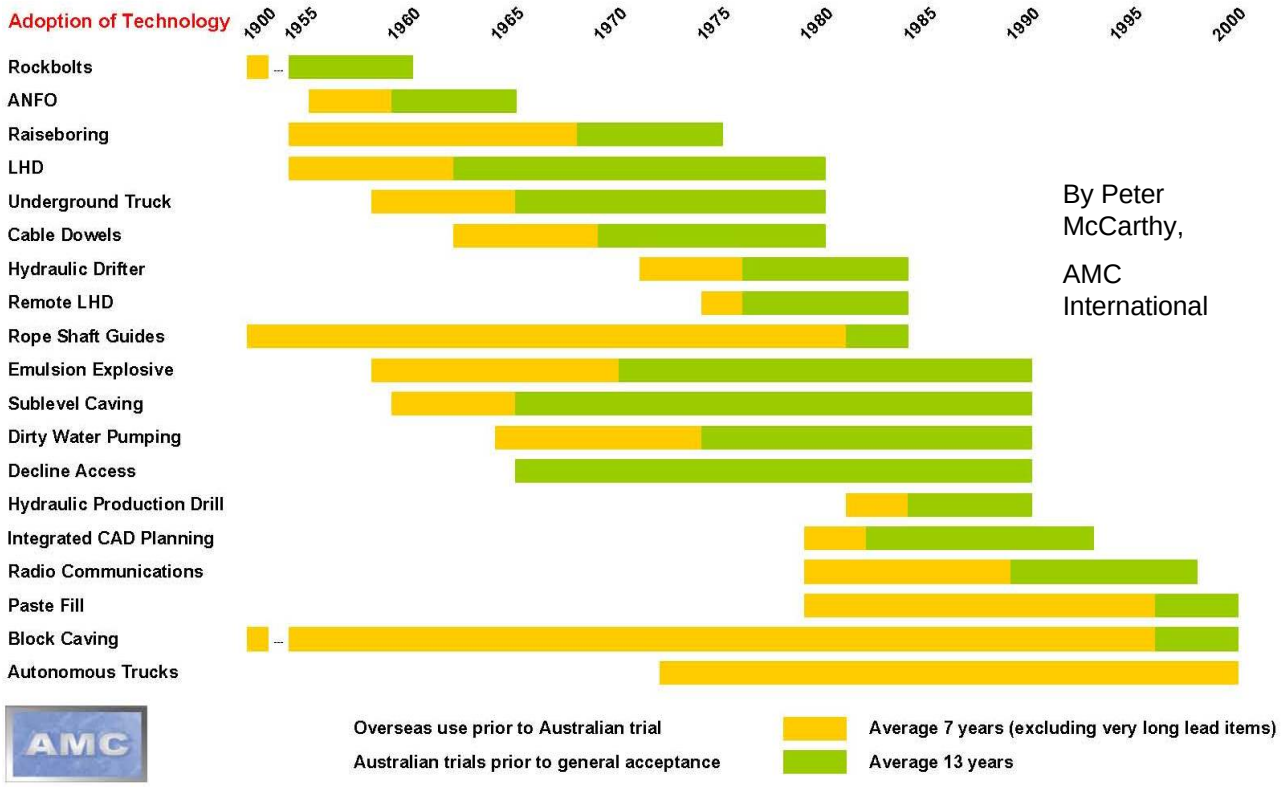
Adequate UHF radio communication & leaky feeder antennas, ~ 1980s

→ Remote & teleremote control



Technology take-up has a long lead-time

- The next step change in mining technology will be delivered through ICT
- Australia punches above its weight in mining ICT
- Australia has an opportunity for further growth into the global market
- Collaboration sought to develop a communication Standard for mining automation and control.



Some step changes are required ~ Technology

- Practical rock cutting ~ hard rock
- Automated digging and stability control
- Better localisation/positioning technology ~ underground
- Machine-based geological sensors
- Communications standards for interoperability ~ automation
- Co-operative tele-robotics ~ long-distance remote control
- New drilling technology
- New logging technology

Some-step changes are required ~ Applications

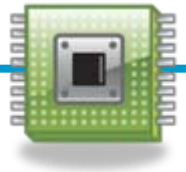
- Automated & rapid underground development and mapping
- Non-entry/automated underground mining
- Insitu leaching
- Geologically guided, remote controlled/automated surface mining

- New generation of drilling technology
  - Making the holes
  - Getting information from the holes

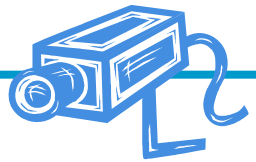
There is a spectrum of tele-robotics & automation



Machine Autonomy



Intelligent Behavior



Extent of Knowledge



Communications Latency



User Interface

Future

Research

Now

Autonomy

Supervisory

Shared Autonomy

Assistive

Manual

Proactive

Reactive

Global

Local

Robot

Tele-Robotic

Tele-Operation

Virtual

Augmented Virtuality

Mixed-Reality

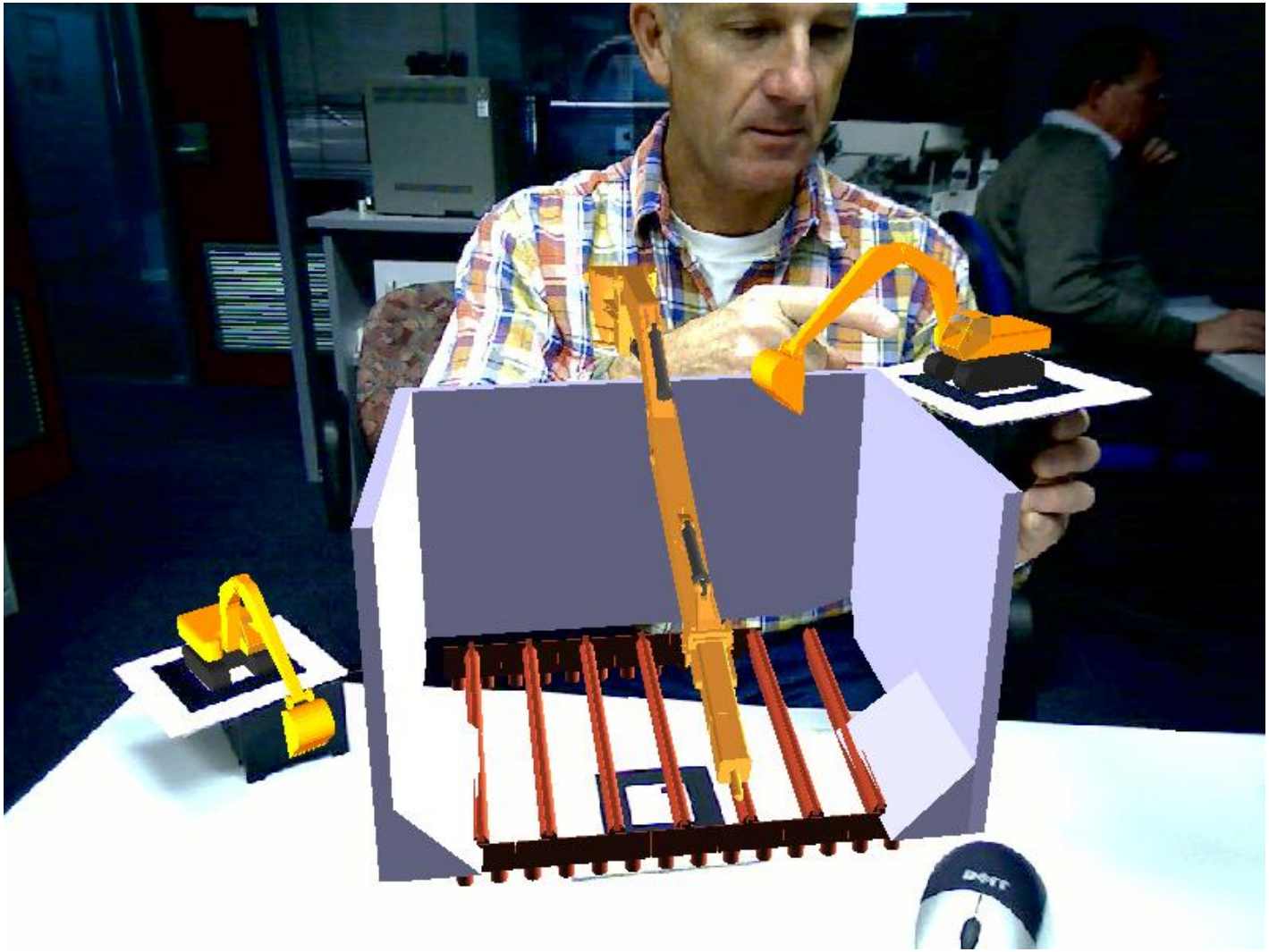
Augmented Reality

Real

Decide on a Target position

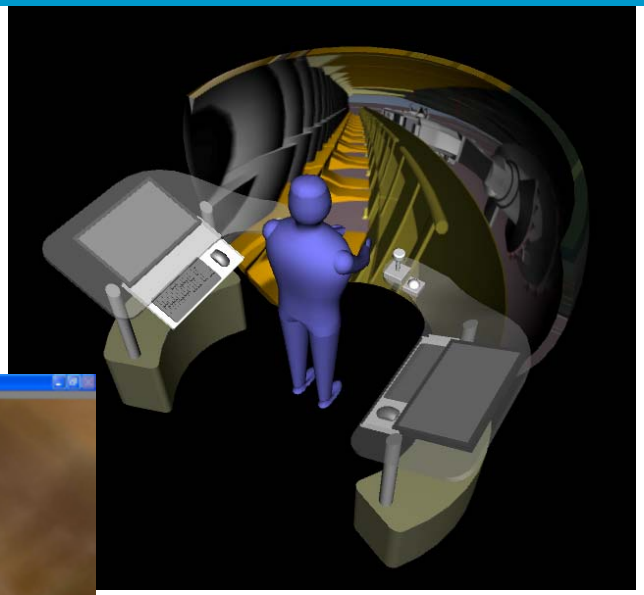
Real and virtual worlds can be mixed for augmented reality

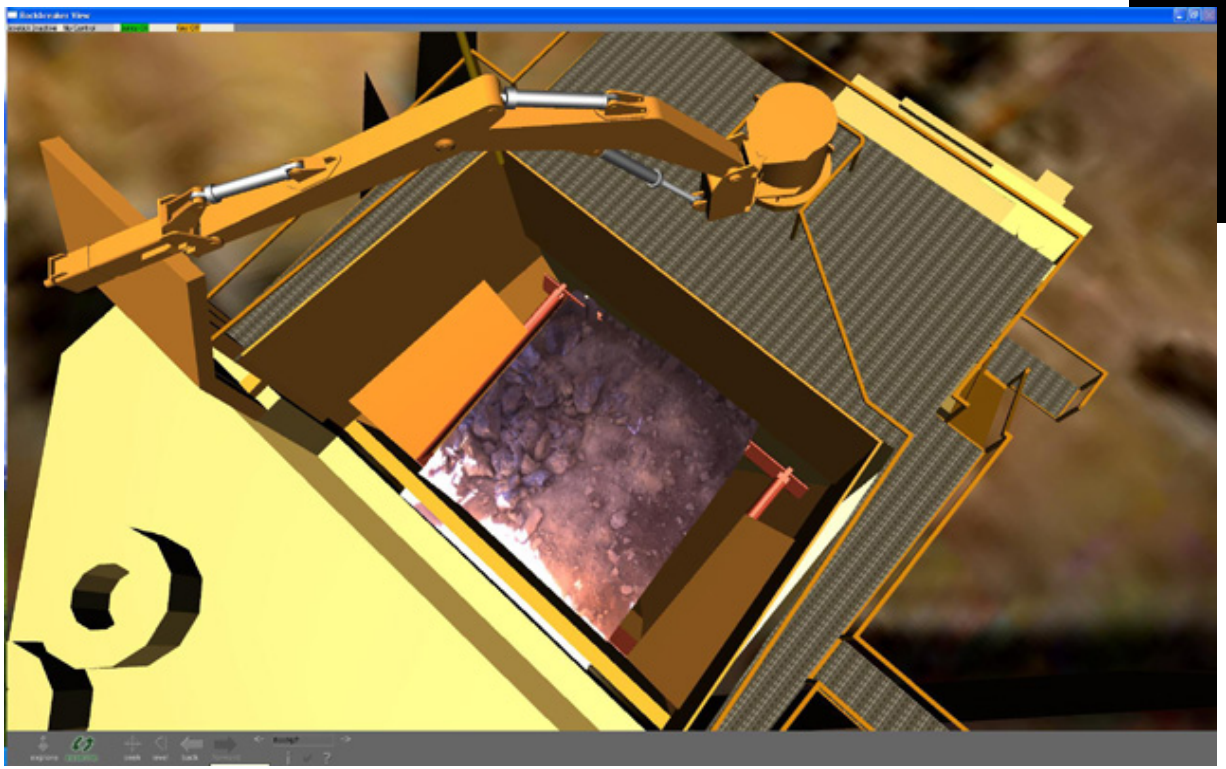
- Only the person is real, the objects on the table are virtual



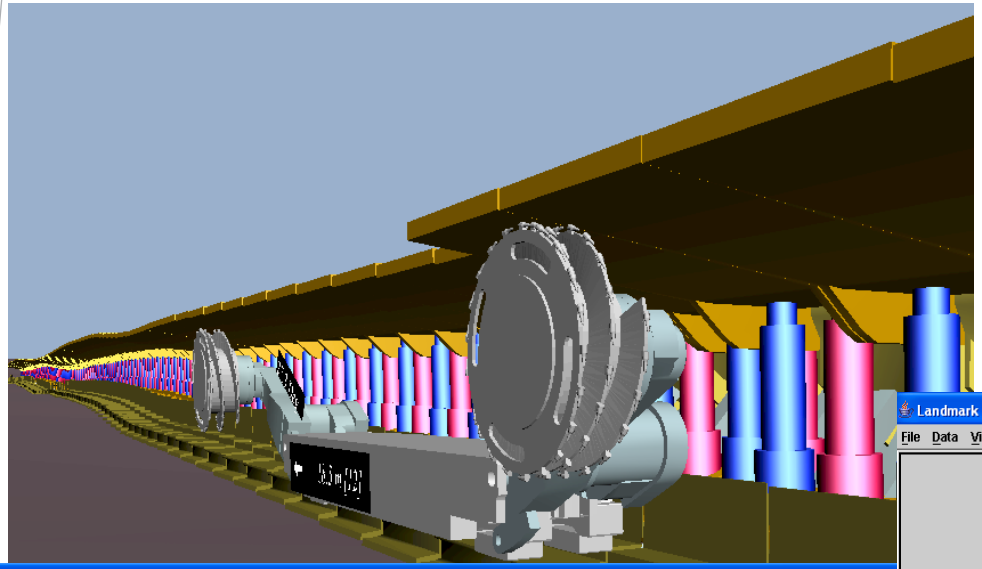
Machine Control Sensors

3D Sensor data integrated with computer model of operating equipment for remote operation

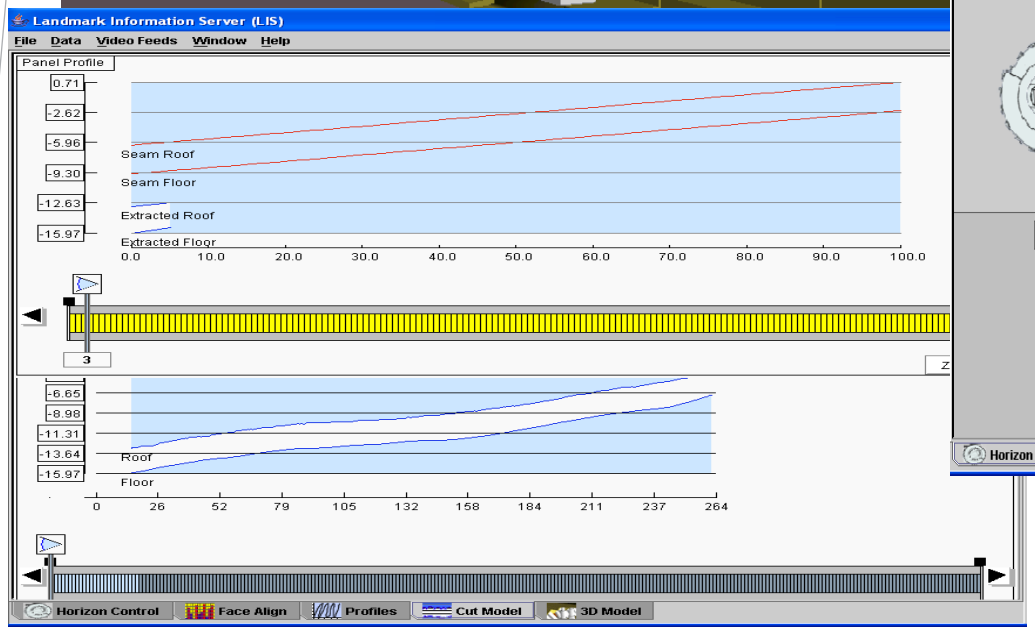


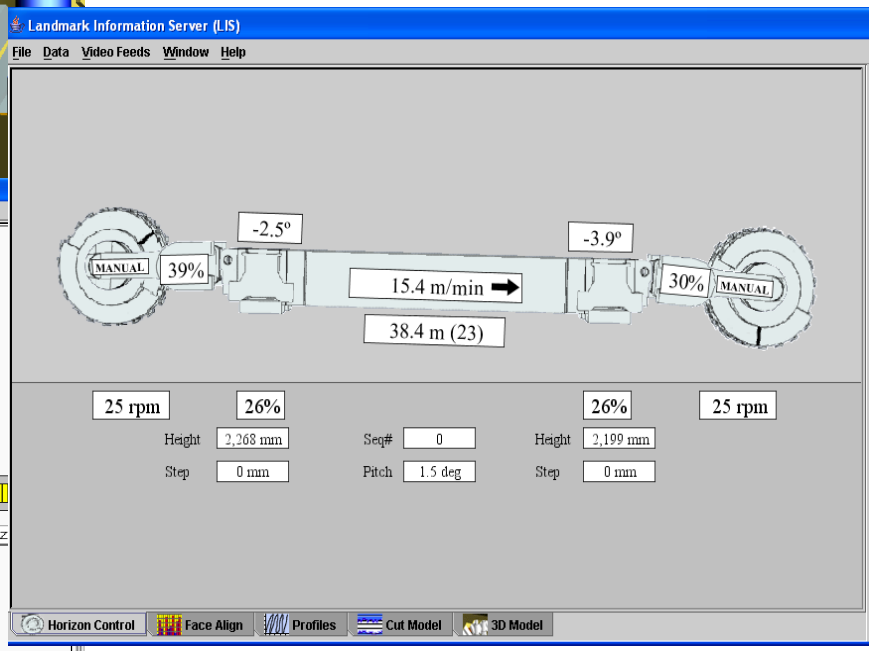


Coal mining automation (Longwall)
3D Visualisation ~ for operator interface



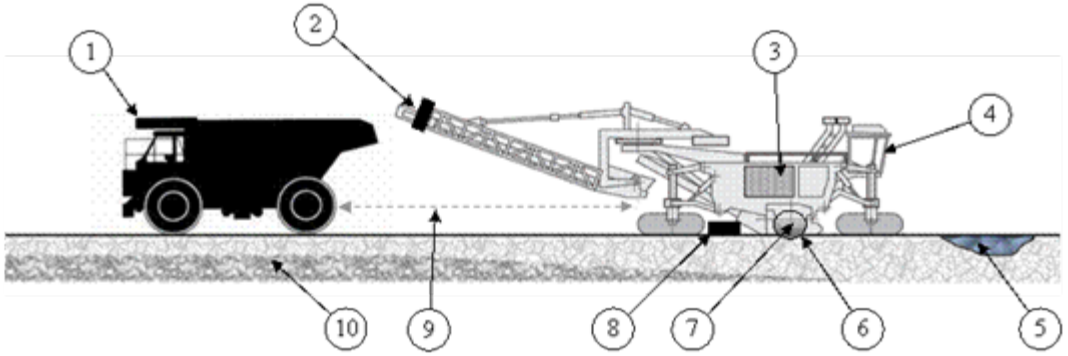
- Information System:
  - Architecture for real-time monitoring of equipment sensors in a 3D geological environment





Geologically intelligent surface mining

- Real time risk measurement
- Little requirement for people to enter the pit ~ set-up & maintenance
- Advanced geological sensors mounted on mining machines
- Real-time feed-back from mining machines to up-date mine plan
- Advanced interfaces for operators & all stake holders
- Greater value will be delivered when unit operations are integrated into a mining system.



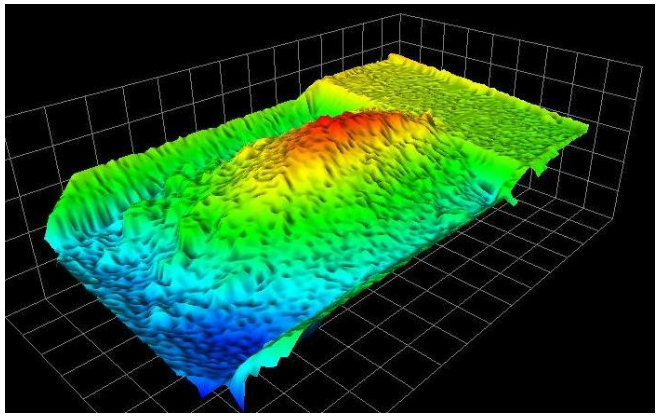
- Possible terrain sensors:
  - Nucleonic
  - Radar
  - Hyperspectral
  - Machine performance/condition sensors
  - Lasers
  - Photogrammetry

SmartCut in 260MPa basalt

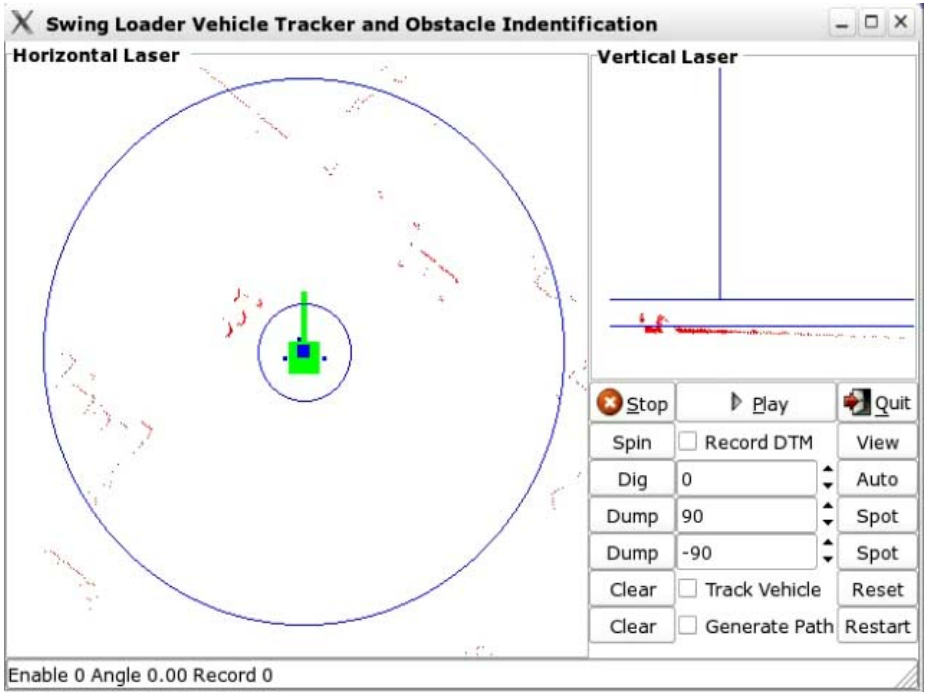


Shovel Dump Assist

Tray Profiling for Optimal Loading



Truck Tracking and Path Planning

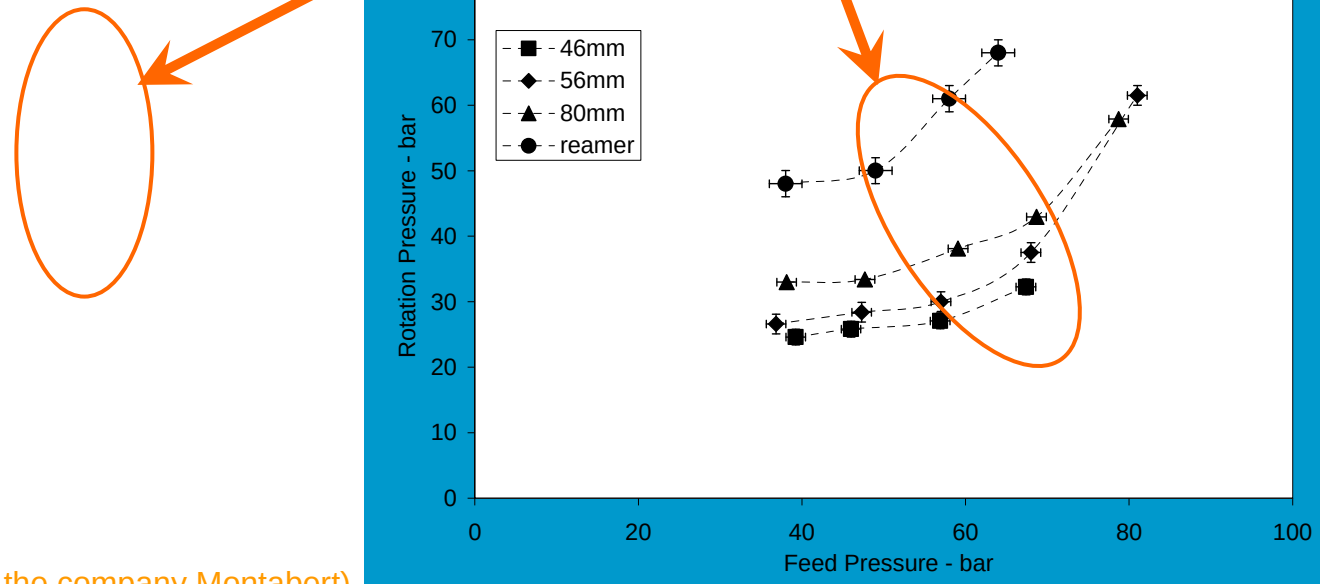


Automated Dumping on Scale Model Shovel x2



Optimising the drilling efficiency

The “sweet-spot” for drill control



(After Pearse 1985 – from the company Montabert)

Theory

Experimental

SMARTRODS

- Investigating fibre composite (flexible, lightweight and high strength) for drill rods, coiled tubing and for housing newer and better sensors for navigation and logging while drilling

