Vertical Openings Inspection System [VOIS]
Development and Applications for Mining
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Problem: Inspect and survey vertical openings in mines in a safe manner

VOIS Development - Conceptual Solution
Deploy a dynamically stabilised platform lowered via cable into the vertical shaft. Mount sensing devices on the platform, such as video, laser scanning, and geophysical instruments.

VOIS Development - Step Changes
- Wire line cable deployment
- 360º panoramic digital video
- Active gyro stabilisation
- Pod decoupling from cable
- Digital control of winch
- Laser profile scanning

VOIS Design - Assembled Components

VOIS Development - Platform Stabilisation
Non Stabilised
Stabilised
Shaft Bottom Panoramic
VOIS Development - Success Through Research

Field Proven Design:
- Steel wire line cable, crane, and electric winch
- Digital "smart" winch control (depth computer and VFD drive)
- Active gyro stabilisation system and platform decoupled slip ring assembly
- Laser scanning using OEM laser profile scanner
- Hybrid DSL combination of deterministic (IDSL) and non-deterministic (VDSL)
- Distributed control processing design aiding rapid development

VOIS Applications for Mining

Tool
- Stabilised platform to capture video images (inspection) and laser data (survey) for vertical openings:
  - Ore passes
  - Ventilation shafts
  - Access shafts

Applications
- Visual inspection of vertical shafts to observe condition and assess stability
- Laser survey of vertical shafts to compare as built to engineering design
- Inspect and survey vertical shafts (ore passes) at timed intervals during production periods to assess condition

VOIS Application - Ore Pass Inspection

- 600 meter vertical raise bore shaft
- Concerns about shaft wear
- Require cost effective means to gather visual data
- Minimal production down time

VOIS Application - Ventilation Shaft Inspection

- Damaged services located at -90 meters showing water ingress
- Location and source of problem is now known
- Mine site resolved issue with grouted ring to stop flow

VOIS Application - Ore Pass Survey

- Production ore passes at Western Australian mine site
- State unknown? Drawn tons exceeding design capacity
- Accurate 3D laser scan required to assess the condition of passes
VOIS Application - Ore Pass Survey
- Accurate 3D representation of ore pass in mine plans +/- 5cm
- Assessment of ore pass state after production interval
- Is more information hiding in the data?????

Conclusions
- Development of viable tool for inspection and survey of vertical shafts
- The tool allows us to carry out inspections and surveys in a safe manner
- Deliver accurate data sets from dangerous areas directly to professionals
- Prototype tested in a mining environment with real-world applications

Future Research
- Design and construction of a production unit
- Step change in data interpretation with fusion of video and DTM data
- Virtual representation of data sets in mine plans

Thank You