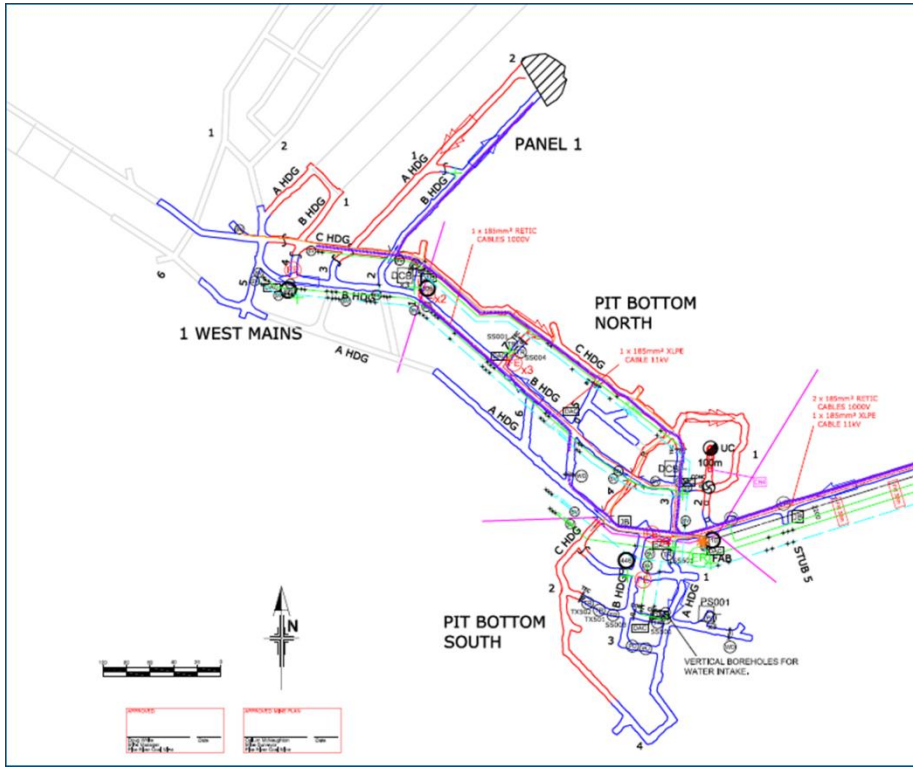
NSW Mines Rescue

Unmanned Aerial Vehicle (UAV)

2015 IMRB Conference

Hanover

Emergency Response



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Likely entry?

Mines Rescue

ACARP Project Number C19010 Emergency Response: Mine Entry Data Management – Extension

Q. Can mines rescue teams enter or remain in a mine, in response to an incident?

A. It depends upon the integrity and reliability of the information about the safety and stability of the underground environment.

Q. Will the systems providing this required information remain operational once an incident occurs?

The Options

Borehole monitoring – slow, single point, not sufficient

Robot – “Numbat” – tried and tried and tried and failed

Potential MRS UAV Applications

A Coal Services

Health & Safety Trust Funded

Research Project

- UAV data collection prior to rescue teams re-entry
- Atmospheric sampling (CH_4, O_2, CO, CO_2)
- Search in smoke for missing people (infrared camera)
- Search in smoke for fire (thermal image camera)
- Explore in irrespirable atmospheres (camera and lights)

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The Challenges

- Confined areas, debris
- Environment- high CH_4, high CO_2, smoke, dust, ventilation current
- Difficulty of manual navigation U/G
- Communication signal strength U/G
- Coal mine approvals – Intrinsically Safe (I.S.) apparatus
- Travel distance - flight time
- Payload restrictions
- Cost

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The Ambitious Target

An Unmanned Aerial Vehicle (UAV) with the following characteristics

- Proximity sensors with automatic distance limiting protection
- Ability to withstand impact damage caused by flying into objects
- Navigation: 2 forms, pre- programmed and pilot driven ability
- Instantaneous communication: (Wi-Fi network will provide a suitable network backbone for live control of UAV drone)
- Intrinsically safe
- Rapidly deployable with up to 10km in range
- Fully battery powered
- Video imaging cameras
- Atmospheric monitoring with ability for both stored and instantaneous readings
- Thermal imaging with ability for both stored and instantaneous readings

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The Steps:

We are still working through Mark 1

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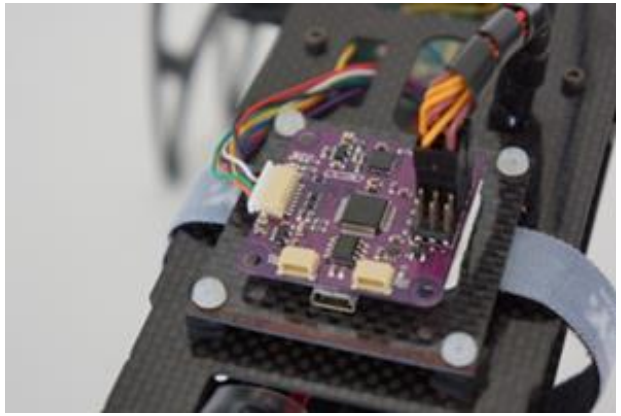
Mark 1	Mark 2	Mark 3
"Proof of Concept"	"Fully operational prototype"	"Operational system"
Product 1 km range Bump proof Communications- able to deploy own wi fi network, Remote control – via on board camera Gas monitoring Payload flexibility (2 kg max) Anti-static materials used	**Product** Proximity sensors Fully set up for underground deployment IS approval	**Product** 10 km range Full scope of operation in terms of: • Distance • Duration • Clarity • Nodes • High definition etc

“Proof of Concept”

Design

Navigation / flight control chips:

- Needs accurate and stable flight control algorithms



Sonar enabled

- Provides consistent programmed flight altitude above ground

Batteries.

- High energy density batteries to provide maximum life

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“Proof of Concept”

Protection

Needs to be protected from the environment:

- Bump proof
- Dust proof
- Water proof
- Intrinsically Safe

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“Proof of Concept”

Atmospheric Gas monitoring

Requires both:

- **multi gas levels monitoring back to base**
- **recording capability**

Custom engineered software required – already developed

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“Proof of Concept”

Video

Requires Video playback to remote pilot of sufficient quality to enable remote operation

- 2 dimensional live visuals back to base: colour or thermal
- Tested nine different cameras to assess their effectiveness to operate in lowlight conditions and their ability to provide a crisp and clear picture
- Also tested the option of utilising 3-D cameras. There is promise in this technology but more work needs to be done to find suitable picture quality.

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“Proof of Concept”

Lighting

UAV needs to supply own lighting system to enable both navigation, flight and capture of relevant information through video cameras

- Navigation up to 20 m with 170 Lumens of LED power with a diffused wide-angle lens. Power has since increased to 300 Lumens.
- Currently testing strip LED lighting on the under side of the carbon frame to provide light directly below the craft to enable vision directly beneath the craft.

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“Proof of Concept”

Navigation & Communication

Pivotal requirement is the need to be controlled from a place of safety with real time communications – via a series of lightweight portable nodes.

- Successfully demonstrated ability of craft to be remotely piloted utilising dual individual signals

- Challenge is to utilise a single signal (dual band) for transmission:
  - video/gas readings
  - craft control

- Prototype Software Designed Radio (SDR) system being developed that allows for data transmission via UAV deployed nodes operating a dual band.

Another option we are investigating is to have programmed flight path with UAV able to self pilot to and from designated location

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“Proof of Concept”

Atmosphere

The craft needs to be able to fly in atmospheres other than normal air.

- High levels of Carbon Dioxide or Methane - may affect the flying characteristics and engine performance

These will be tested during the next phase

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“Proof of Concept”

1st Test Flight

18 March, 2015

Southern Mines Rescue Training Mine

VIDEO of test flight inserted here

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“Proof of Concept”

Product Delivery

“Mark 1” requirements anticipated to be demonstrated at 2nd Test flight at an operating underground coal mine in September 2015.

We will keep you updated, and appreciate sharing any ideas you may have in this area!

Thankyou

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