Monitoring the vegetation success of a rehabilitated mine site using multispectral UAV imagery

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About the Supervising Scientist

Main roles

• Working to protect the environment through environmental research and monitoring, environmental supervision, audit and inspection.

• Ensuring the protection of the Alligator Rivers Region from the effects of uranium mining and encouraging best practice in wetland conservation and management.
Ranger Uranium Mine

- Scheduled to cease operations in 2021
- Rehabilitated by 2026
- Needs a comprehensive monitoring program to ensure integrity of rehabilitation
Monitoring of rehabilitation

- Plot based ecological methods
- Limited due to accessibility and resources
- Does not fully represent the biodiversity and spatial heterogeneity within these landscapes
Remote sensing

• Can capture the biodiversity and spatial heterogeniety within these landscapes
• Provides total coverage of rehabilitated areas
• Can extract environmental variables relevant to monitoring
  – eg plant health, fractional cover
Why go UAV?

• Area under study is small
• Hi-resolution satellite data is expensive and not available on regular intervals (cloud, smoke haze)
• Manned aerial photography is ideal but expensive to deploy
• UAS is potentially a cost effective monitoring tool
Aim of this project

To develop and establish the use of UAVs for the monitoring of mine site rehabilitation

- in particular revegetation and erosion
UAS platform

- Swampfox X5
  - Skycam UAV
    - www.kahunet.co.nz
  - 2.3 m wingspan
  - Electric motor
  - Hawk AP and GCS (DTA NZ)

- Rugged and easily patched
- Bungee launch
- Parachute recovery
Sensor payload

• 2 modified Sony NEX5 16MP digital cameras
  – 1 RGB
  – 1 full spectrum
    : Hoya R72 High Pass 720 nm NIR filter
  – 1.5 frames per second
Study site

• Jabiluka mine site
  – Rehabilitated in October 2013
  – Provides an ideal study site for testing and development
Data acquisition

• Dates:
  – 28 April 2014
  – 13 June 2104
  – 23 September 2014
  – 23 December 2014
  – 23 April 2015

• Guided flights
  – Mowing the lawn

• Sufficient overlap
  – +50% side
  – +80% forward
Geometric and radiometric correction

- GCPs marked and recorded with DGPS
- Black and white reference panels for radiometric correction
Data processing

• Processes
  – Photo correction – vignetting, pixel differences
  – Photo alignment – camera parameters, UAV location and attitude
  – Automated tie point extraction
  – Dense point cloud reconstruction
  – Meshing
  – Surface model and orthomosaic creation
Photo orientation
Outputs

- Dense point cloud
- RGB orthomosaic
- NIR orthomosaic – GSD 4 cm
- DSM – GSD 12 cm
Point cloud
June 2014
December 2014
September 2014
December 2014
Plants alive in April 2014
Plants still alive in June 2014
Plants still alive in June 2014
+ dead plants
Plants still alive in June 2014

volunteers
Plants still alive in September 2014
Plants still alive in September 2014
+ dead plants
Plants still alive in September 2014
volunteers
The four Grevilleas

April 2014
The four Grevilleas

June 2014
The four Grevilleas

September 2014
The four Grevilleas

December 2014
Conclusion

So far:

- UAV data fills a niche between field work and satellite data
- Sparse trees aren’t good for automatic tie points – increased overlap may help
- The best times of day for flying do not align with time preferred for image capture
Future work

• Using the multi-temporal UAV data to describe:
  – the seasonality of plant growth phases;
  – further analysis of structural, spectral and textural information to discriminate tree and ground cover;
  – erosion detection
  – trialling other sensors.
Fractional cover

• The proportion of various ground covers
  – typically bare ground, non-PS vegetation, and PS or green vegetation

• Proportions can be an indicator of condition
Image analysis

Classification – step wise ‘tree’ model
Becoming operational

• Steps:
  – Develop photogrammetric workflow
  – Automated approach to image analysis
  – Change detection