Koala location research - Unmanned Aerial Vehicles

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Key components

- **Koala detection prior to tree harvesting in eucalypt plantations.**
- **Unmanned Aerial Vehicles fitted with thermal digital imaging and multi-spectral cameras and 'koala-identification' software algorithms.**
- **Development of plantation management tools to optimise koala welfare and worker safety.**
- **Cost effective commercial application possible.**
- **Further work needed to improve commercial applications.**

Context

In some localities koalas occupy commercial eucalypt plantations. Their presence creates challenges for forest managers when conducting tree harvesting operations. To date the detection of koalas prior to harvesting has proven difficult and dangerous. This project offers cost effective technology and management practices to detect koalas, and to optimise their welfare ahead of harvesting.

Digital imaging systems mounted on Unmanned Aerial Vehicles (UAV's) have become more sophisticated and cost-effective. These systems include a wide range of cameras and mounting devices along with increased computing power to analyse images. This technology, in combination with ecological knowledge and computer algorithms developed by the Australian Centre for Field Robotics (ACFR) now offer a possible alternative to manual ground-based plantation and forest assessments.

Objectives

The research project objectives were to:

1. Improve speed and accuracy in locating koalas in advance of tree harvesting.
2. Deliver a system based on UAV's that provides benefits to industry, ranging from decreased staff and equipment costs to improved accuracy of koala population assessments.
3. Provide precision in locating koalas.
4. Provide access to terrain that would otherwise be dangerous or difficult on foot and reduce the associated safety concerns when traversing these areas.

A 'proof of concept' was required to locate koalas in eucalypt plantations using UAV's fitted with thermal digital imaging and multi-spectral cameras and suitable 'koala-identification' software algorithms.

UAV outputs need to include locations in latitude and longitude to identify koala-trees prior to harvesting. This will reduce the time and cost, and improve the safety associated with current manual koala detection techniques.

Data generated was sent to ACFR for processing and for the enhanced development of an algorithm that would allow computer identification of koala locations. This data then provides specific location coordinates to forest managers in real time so that koalas could be avoided during harvesting.

Five trials in the Bessiebelle tree plantation area in western Victoria using various settings, heights and image overlaps were studied over several months.

UAV's fitted with specialist cameras and 'koala-identification' algorithms to detect koalas before tree harvesting.

Project methodology and deliverables

The project methodology and deliverables were:

1. The creation of a set of raw data files from flight imagery using the UAV mounted camera(s).
2. Conversion of raw data to an orthomosaic map[1] of study areas.
3. Identification of koalas as latitude and longitude coordinates, and where possible indicative vertical position information.
4. Identification of koalas from ground-based cameras.
5. Report with key findings, objective analysis of the proposed methodology for commercial operations. Key research weakness and opportunities were identified and a series of recommendations for progression beyond the 'proof of concept' stage of the research.

Discussion

Improved speed and accuracy in locating koalas in advance of tree harvesting has the potential to deliver considerable savings, including decreased staff and equipment costs. Also improved accuracy in koala population counts, precision in locating koalas, enhance animal welfare, and reductions in risks from field work.

Current manual methods to identify koalas in eucalypt plantations in advance of tree harvesting are time consuming and costly. A successful UAV based system will be safe, cost effective, timely and precise. Technological advances include:

1. An improvement in koala detection algorithms.
2. The discovery of alternate methods of data processing and advancement of associated hardware.
3. The increase in thermal camera accuracy and technology.
4. An improvement in data presentation methods.

During research trials, several camera and algorithm settings and processes were developed that enabled koalas to be located and the system demonstrated. A fully operational system would include preliminary location of koalas in real time using visual techniques and the isotherm setting on a specialised camera. Researchers noted that there will be seasonal impacts where koalas are highly mobile and aggressive suggesting that seasonal factors will need to be identified in the next stage of research.

The ACFR computer algorithm was successful in identifying koalas, although with some false readings. The algorithm is a continuous learning system and will improve over time with continued data collection and use enabling removal of incorrectly identified animals.

While further development is required, operational use of the system could be conducted with minimum field personnel, while at the same time improving safety and animal welfare.

Outcomes

The research project resulted in several key lessons including:

1. Koalas can be located using the isotherm setting on the thermal digital imaging camera.
2. Lower UAV altitudes improved computer algorithm koala detection. All flights should be conducted between 50 and 60 metres.
3. Increased flight overlap will improve detection. All flights should be conducted at 70 per cent or greater overlap.
4. Cheaper operational equipment needs to be identified to reduce the risk of loss.
5. As the day temperature rises it becomes increasingly difficult to identify koalas so early commencement of operations is essential.
6. It was noted that at full operational speed the flight can cover 100 by 150 metres of plantation in just 4-6 minutes, allowing sufficient time to locate koalas during full-time operations.

Future research and development

Australian Bluegum Plantations, owner and manager of the Bessiebelle tree plantation where the research was carried out, endorse the desirability of undertaking additional research. The company expressed the view that improvements to the efficiency of the UAV-based technology would be valuable so that real time data on koala presence would not only contribute to their protection, but also be a major safety benefit during tree harvesting operations, especially having the confidence to remove 'koala spotters' positioned on the ground in close proximity to harvesting machinery.

To finalise a commercial operational technique researchers suggest further work including additional data collection to refine algorithm performance that will also require some 'ground proofing'. Also the desirability of designing and installing inboard processing to enable real time computer data processing; further system field trials, and additional specialist camera testing to confirm data reliability.

1. An orthomosaic map is a detailed, accurate photo representation of an area, created out of several photos that have been assembled together and geometrically corrected so that the photo representation is as accurate as a map.

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