DISASTER LANDSCAPE ATTRIBUTION
LOW COST 3D MONITORING OF FUEL HAZARD

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IN THE LAST DECADE A RANGE OF SENSING TECHNOLOGIES, TECHNIQUES AND PLATFORMS HAVE EMERGED TO CAPTURE 3D STRUCTURAL INFORMATION. PROJECT A4 EXPLORES THESE SYSTEMS AS ALTERNATIVE QUANTITATIVE SOLUTIONS TO TRADITIONAL FUEL HAZARD AND FIRE SEVERITY EVALUATIONS.

RESEARCH OBJECTIVES

The objective of this research is to identify and evaluate the potential of low-cost sensing technologies and data capture platforms that allow the rapid and quantitative characterization of the 3D structure of fire prone environments. This poster outlines the research undertaken to date to assess how well the data provided by these low-cost technologies describe fuel hazard conditions.

"For a number of years there is an identified need to obtain a cost effective method to capture quantifiable fuel type characteristics through remote sensing, this research could open endless possibilities." (D. Taylor, Department of Primary Industries, Parks, Water and Environment, Tasmania)

3D SENSING TECHONOLOGIES

Structure from Motion

Utilising overlapping optical imagery to derive 3D structure has re-emerged as a viable technique to map our environment. Structure from Motion (SfM), is one such technique that can generate dense 3D point clouds (figure 1a). Using SfM, low-cost Point-and-shoot cameras provide sufficient information to generate high-density structural information describing the surrounding environment.

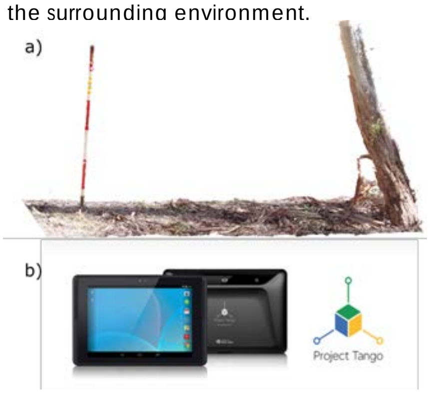

Figure 1. a) SfM point cloud and b) an example structured light device.

Structured Light

Structured light cameras emit an infrared light pattern that is captured by a CCD camera and variations in pattern are used to estimate depth (figure 1b). Commercially available cameras are highly optimized for indoor environments. Initial testing using a Project Tango camera (a Google development tablet made available to the research team via invitation) in outdoor conditions indicates this technology shows potential. However, the underlying functionality requires further development for use as a viable fuel hazard mapping tool.

Platforms

Unmanned Aerial Systems (UAS) are a rapidly developing platform that have the potential to revolutionise the capture of remote sensing data. UAS's have been shown to capture data representing increasingly wide areas at very high resolution. Initial tests utilising a UAS to capture laser scanning and SfM data have demonstrated the ability of UAS's to characterise fire prone environments (Figure 2).

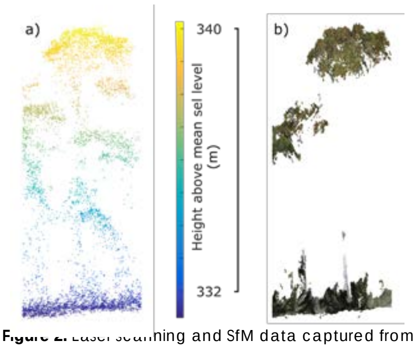

Figure 2. Laser scanning and SfM data captured from a UAS platform.

Terrestrial platforms both mobile and static are viable for deploying low-cost sensors to capture detailed fuel hazard information particular in areas of high canopy cover where airborne platforms often fail.

STRUCTURE FROM MOTION PILOT STUDY

The utility of SfM and associated sampling methods for characterising fuel hazard in was tested in 2 plots were established in Australian fire prone landscapes.

Method

12 downward looking photographs were captured at 10 randomly located samples. The photos were used to generate SfM point clouds (figure 3a). TLS data was also captured at the plot level (figure 3b).

Fuel load representation

Strong correlation ($r^2 > 0.8$) was found between dry weight and SfM and TLS derived volume metrics at the two sites.

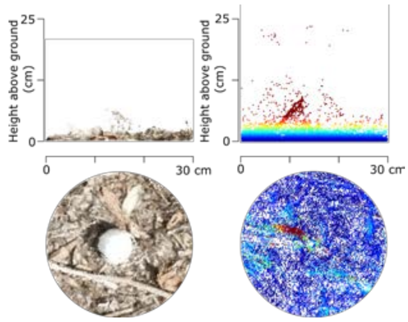

Figure 3. a) Point clouds captured using TLS and SfM techniques. b) plots showing dry weight against TLS and SfM estimate volume.

Conclusions

SfM potentially provides an efficient, easily captured technique to attribute fuel hazard. This pilot study established the utility of this technique to capture a representation of near surface fuel load. Future work will focus on developing sampling guidelines to allow more rapid data capture and produce point clouds in more complex landscapes.