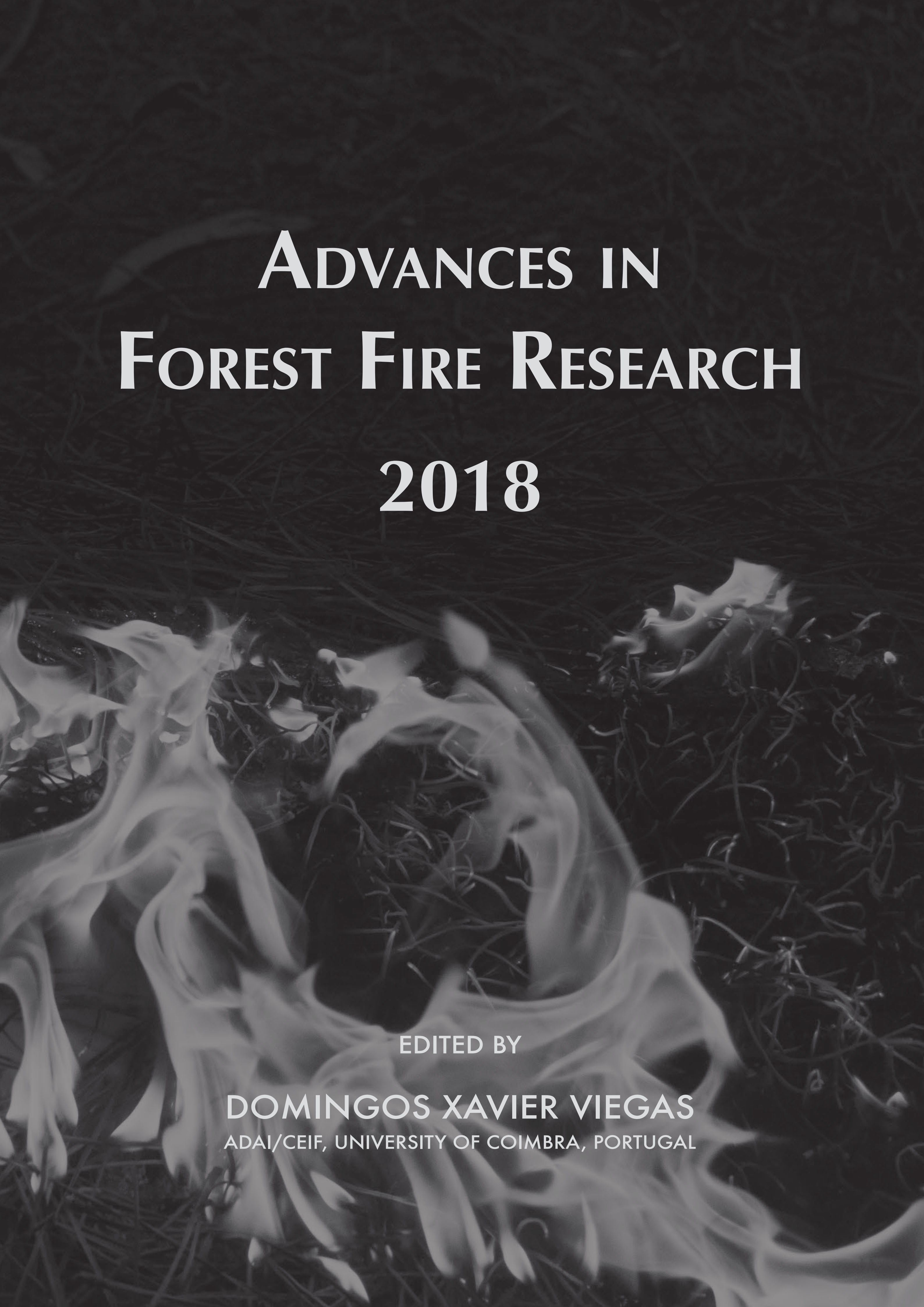
ADVANCES IN FOREST FIRE RESEARCH 2018



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Short contribution – Fuel Management

A rapid technique to quantify bark fuel hazard with smartphones

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Abstract

In eucalypt forests, tree bark can be a major contributor to the potential spread and behaviour of a wildfire and suppression difficulty. In particular, very fine fibres of bark found on eucalypt stringybark provides highly flammable material that can produce large quantities of embers and short distance spotting. In contrast, long strips or ribbons of bark can produce substantial spotting at distances greater than 2km. Due to these impacts on fire behaviour, land managers emphasise the importance of assessing bark within their hazard evaluation protocols and may target specific mitigation approaches via prescribed burning to reduce the hazard. Such hazard assessments not only inform prescribed burning priorities but also play an important role as input variables into fire spread and behaviour models. Bark type, thickness, size and shape are assessed in combination with the attachment characteristics to determine the potential hazard posed by the trees within the forest. Having accurate, reliable and quantitative information is necessary for input into these models. To date, assessment of bark hazard relies on qualitative and subjective visual assessments. In this paper we present an alternative to visual assessments by using image analysis and photogrammetry (or remote sensing) techniques applied to photographs taken using smartphones.

Keywords: Bark, Fire Behaviour, Fuel Hazard, Remote sensing,

1. Introduction

In eucalypt forests, tree bark can be a major contributor to the potential spread and behaviour of a wildfire and suppression difficulty. In particular, very fine fibres of bark found on eucalypt stringybark provides highly flammable material that can produce large quantities of embers and short distance spotting. In contrast, long strips or ribbons of bark can produce substantial spotting at distances greater than 2km. Due to these impacts on fire behaviour, land managers emphasise the importance of assessing bark within their hazard evaluation protocols and may target specific mitigation approaches via prescribed burning to reduce the hazard. Such hazard assessments not only inform prescribed burning priorities but also play an important role as input variables into fire spread and behaviour models. Bark type, thickness, size and shape are assessed in combination with the attachment characteristics to determine the potential hazard posed by the trees within the forest. Having accurate, reliable and quantitative information is necessary for input into these models. To date, assessment of bark hazard relies on qualitative and subjective visual assessments. In this paper we present an alternative to visual assessments by using image analysis and photogrammetry (or remote sensing) techniques applied to photographs taken using smartphones.

2. Method

2.1. Bark Class Definitions and Inter-comparison Data

Bark was classified using the methodology outlined in the Overall Fine Fuel Hazard Guide (McCarthy et al. 1999). This method of assessment separates bark into three main categories - stringybark/fine fibrous, ribbon/candle and other bark types. Visual inspection of the bark aims to assign hazard ratings based on the thickness, size and shape of bark pieces, relative quantity of bark and the nature of attachment to the tree. The process results in a categorical hazard estimate for the bark on a single stem. For each tree assessed in this study the process outlined in McCarthy et al. (1999) was undertaken for inter-comparison with the remote sensing approach.

2.2. Processing workflow

Remote sensing techniques have been recently employed to measure the properties of bark (Othmani et al. 2013). These approaches often employ high resolution images or highly accurate laser scans of the bark surface from which measures of texture can be derived. These texture measures can be then used with machine or deep learning approaches to enable species to be accurately distinguished.

In this paper 3D bark maps are created from three to six overlapping photos captured from a single vantage points. The four photos are imported into Agisoft Photoscan which is used to generate a dense point cloud. The point clouds are then passed through a workflow (figure 1) which allows bark depth to be recovered. Following descriptor metrics are extracted for use in a random forest classifier.

In this study images 350 trees were collected with a minimum of 30 trees of each hazard type. This set of trees was divided into training and validation sets for use with the random forest classifier.

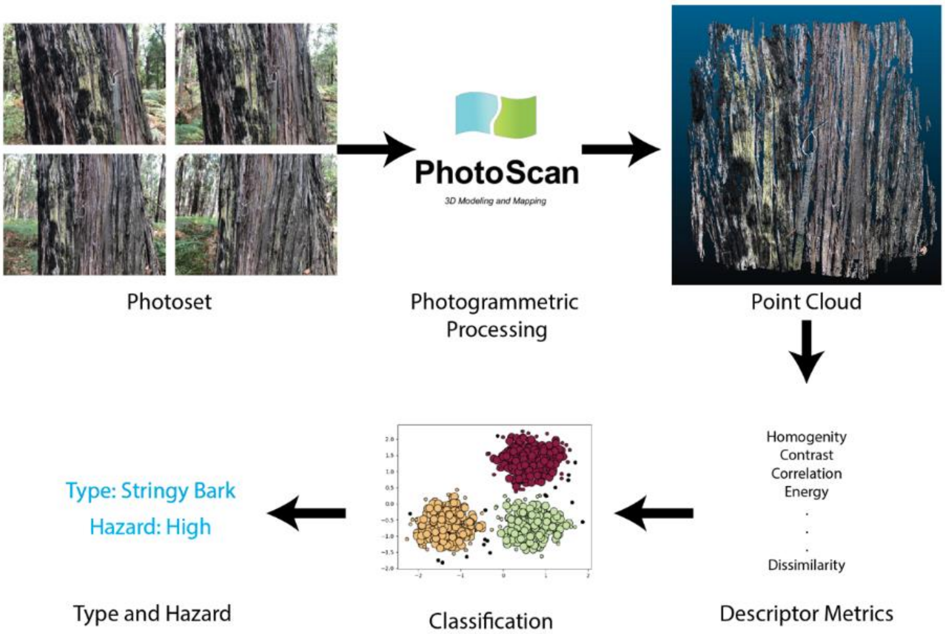

Figure 1 - Workflow used to generate bark texture metrics and the final classification.

3. Results and discussion

The bark classification shows a high rate of agreement with field observations of type and hazard. The process can also be run in the field on a smartphone device for real-time assessment of bark hazard.

Although this paper only addresses the bark component of fuel hazard similar methods have been previously used to provide estimates of surface and near-surface fuels with greater reliability than achieved in the visual inspection approach (Spits et al. 2017). Once the accuracy of these methods have been fully established, the metrics, which are quantifiable and objective, will enhance the input data available for use in existing and next generation fire behaviour models.

4. References

McCarthy, G. J., Tolhurst, K. G., & Chatto, K. (1999). *Overall fuel hazard guide*. Fire Management, Department of Natural Resources & Environment.

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