**Estimating Firebrand Shape & Size from Multiple Video Cameras using Deep Learning**

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Wildland fires have caused significant destruction to communities in Australia, Greece, Portugal, Spain, and the USA. The 2007 Southern California Fire displaced more than 300,000 people, destroyed over 1,000 structures, and resulted in $1B paid by insurers in 2007 alone. WUI fires continue to burn in the USA and are rapidly getting worse; most recently, the tragic Camp Fire in California in 2018.

When vegetation and structures burn in large outdoor fires, pieces of burning material, known as firebrands, are generated, become lofted, and may be carried by the wind. This results in showers of wind-driven firebrands that may land ahead of the fire front, igniting vegetation and structures, and spreading the fire very fast. Post-fire disaster studies indicate that firebrand showers are a significant factor in the fire spread of multiple large outdoor fires.

To protect communities from firebrand ignition, it is critical to understand the shape, size and characteristics of the firebrand shower. In this project, we use image data collected from a system of 4 video cameras to characterize the firebrands. The research questions that we want to answer through this project include:

1. Can Convolution Neural Network (CNN) trained on video images collected from a system of four cameras accurately classify the firebrands (as cylindrical, spherical or disk-shaped firebrands)
2. Can CNN networks combine image and non-image data along with regression techniques to predict the length, width, height and volume of the firebrands.

We plan to use the following advanced techniques, learned during the AI-2 course for attempting the research tasks

1. Data augmentation techniques for image data
2. Transfer learning techniques: Use of Mobile Net trained on ImageNet data
3. Evaluate confusion matrix for multi-class classification
4. Saliency and GradCAM to understand which images are not classified correctly. What can be done to improve classification accuracy?
5. Use of Functional APIs to combine image and non-image tabular data for CNN regression analysis to predict firebrand size (length, width, height, volume and orientation)
6. Visualize intermediate feature maps, learned weights and LambdaCallbacks to analyse vanishing gradients and overfitting (if any)