**AUTOMATING SUB-PIXEL FIREBALL POSITION IDENTIFICATION IN LONG EXPOSURE DIGITAL IMAGES.**

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**Introduction:** Imaging of meteor fireballs (FB) on a multi-camera network allows calculation of its orbit, origin, fall position, mass, velocity, and brightness [1]. Large networks capturing many FB events (each on multiple cameras), like the Desert Fireball Network (DFN) in Australia, offer a large dataset [2]. To make analysis of the data practical, an automated system of data reduction is required. The images of the DFN are unique in that a coded shutter sequence is used to determine the timing of a fireball trajectory within a long exposure image. This shutter modulation follows a de Bruijin sequence and causes the luminous trajectory of a FB to be dashed [3]. After a FB is detected in an image, we present an automated computational system to assist with determination of the start and end (SE) locations of these dashes [3]. Determining these values from multiple cameras allows the parameters to be triangulated in 3D space, and with de Brujin sequencing, provide velocities and absolute timing information. Terminal FB mass can then be determined by using deceleration as a proxy for mass loss [1]. A single event of interest contains upward of 70 SE points (20 per second of FB duration), requiring sub-pixel precision. Without an automated method, this would be a tedious and time consuming process. Here we present the progress of the automated system and the tools in use and development.

**Method:** A series of graphical user interface (GUI) and data processing tools have been developed to assist with the pipeline and minimize manual input.

*Curve:* Fisheye lenses in the cameras result in a curvilinear mapping of the trajectory into image space. SE points need to be detected along the curved trajectory in the image. At this stage, a simple GUI tool has been developed to allow a user to fit a cubic Bezier curve to the FB trajectory.

*Detection:* This Bezier, using bilinear interpolation, samples the image at sub-pixel resolution to provide a brightness curve. Along the brightness curve, a start or end point may be identified by a large change in pixel brightness value, i.e. peaks in the gradient.

*Detection Verification:* Due to artifacts such as stars, the detection stage may result in a small number of false positives and negatives. A second GUI tool allows a user to visualize the SE points that have been identified, and correct for these.

**Results and Conclusion:** The system is currently being used in analysis of FB events of interest, and has significantly reduced the amount of manual input required. The points are subsequently being successfully used for triangulation of the events. Recent growth in the DFN [5], and the further development of infrastructure and software will make this an integral part of the automated FB analysis system.

**References:** [1] Sansom, E. K. et. al. 2014. Abstract #1591. *45th Lunar and Planetary Science Conference.* [2] Bland, P. A. et. al. 2014. Abstract #5287. *77th Annual Met. Soc. Meeting.* [3] Howie, R. M. et. al. 2015. Abstract #1743. *46th Lunar and Planetary Science Conference.* [5] Sansom, E. K. et. al. 2015 (*This Conference).*