Photometry of Celestial Fireballs

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Introduction

To protect space endeavors, more information is needed about the near-Earth meteoroid population. We created a portable all-sky camera system that hopes to increase the flexibility and affordability of meteoroid observation systems. This project focused on writing software perform accurate photometric data reduction.

Objectives

- Create a program that can analyze moving photometric data from meteor video
- Test program on known events to test its accuracy and validity
- Use program to analyze events captured by our own all-sky camera

Our All-Sky Camera

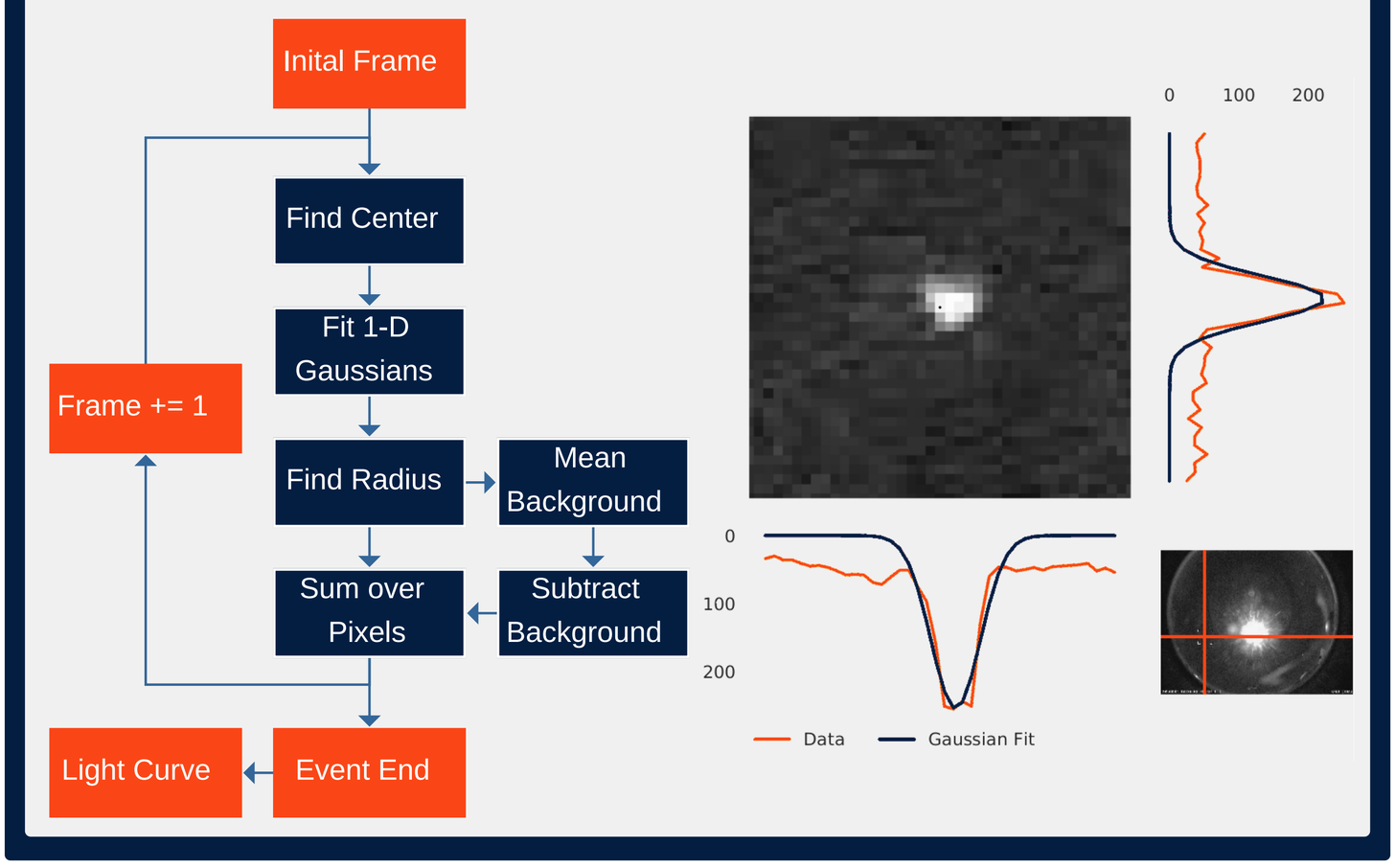
Mathematical Methods

Our camera reports light **intensity** as an 8-bit integer value, ranging from 0 to 255. Summing over the intensity values for each pixel in an event approximates the total intensity of the event. We use Equation 1 to turn that into an uncalibrated **magnitude**, which is a log scale and generally how astronomical brightnesses are reported.

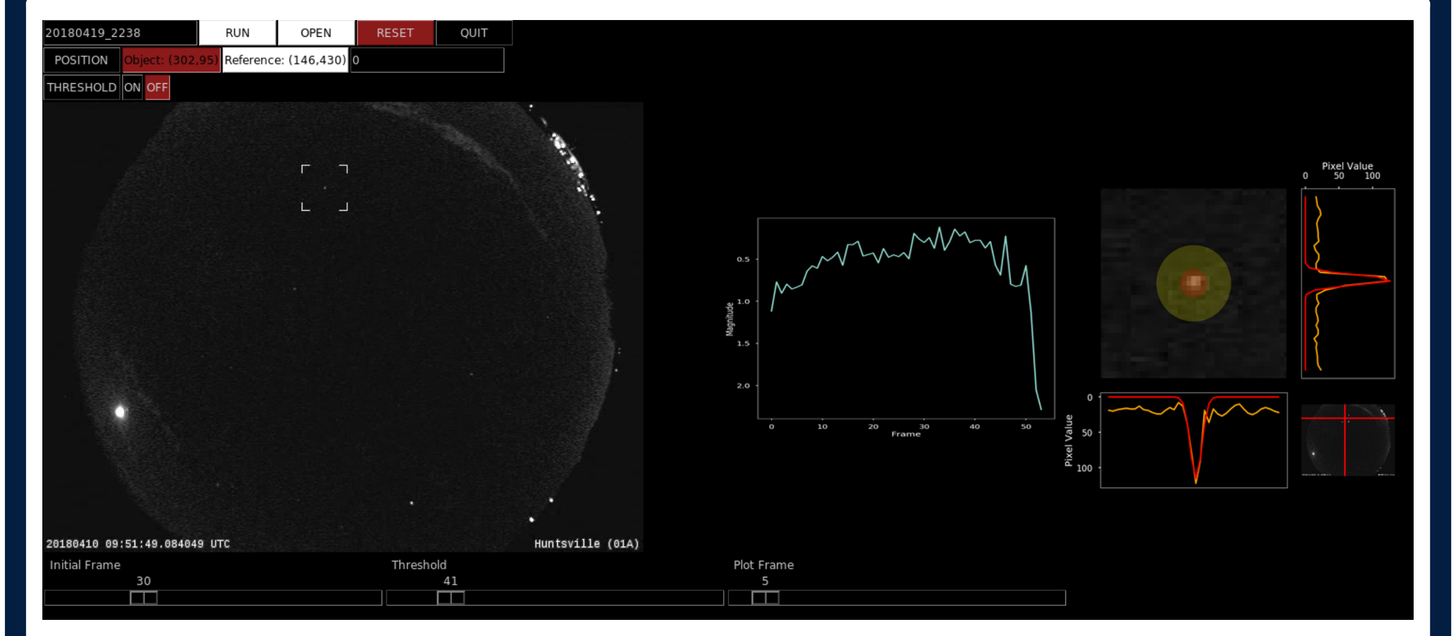
$$m = -2.5 \log \left(\sum_{pixels} I \right) \tag{1}$$

This magnitude is uncalibrated however, and measurements from different systems would disagree as to its value. The system is calibrated by observing a star of known magnitude during the event. This yields a correction factor needed to relate the sum of the pixels to the known magnitude. This correction factor is then applied to the unknown magnitude to determine the calibrated apparent magnitude of the event.

Analysis Procedure



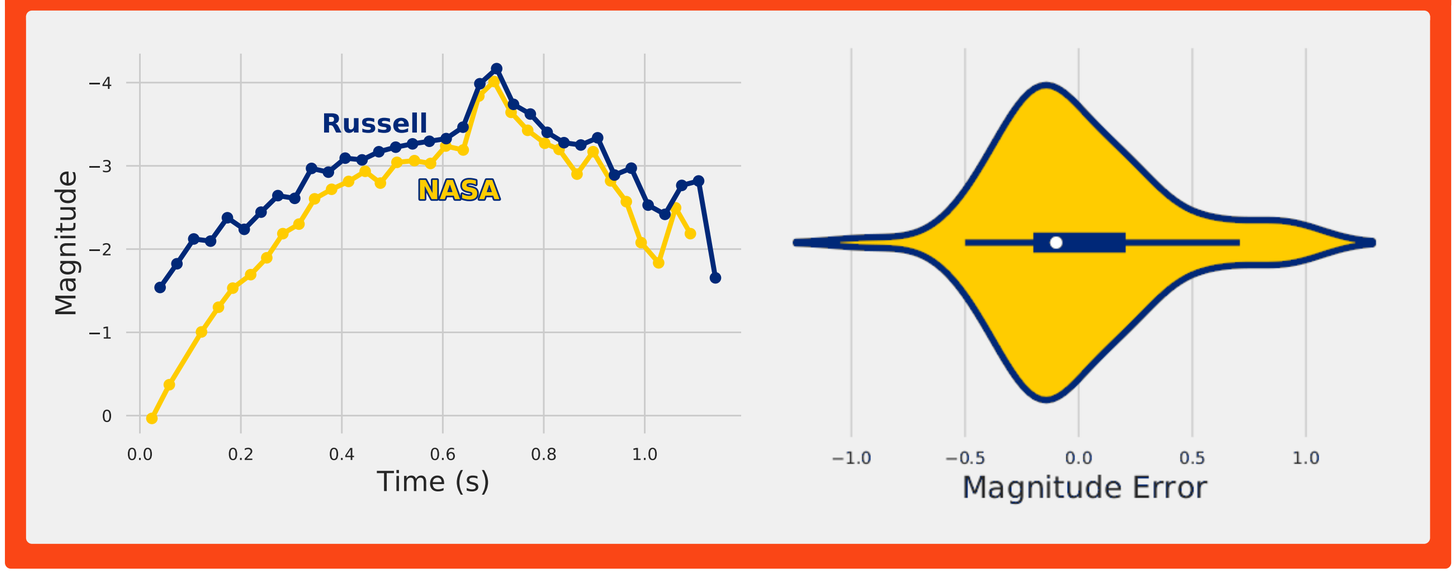
Photometry Program



Results

As a test, the program was run on meteor events collected by NASA's ASGARD all-sky network. Lightcurves are also available for this data, and serve as a useful comparison and analysis check. On all comparisons thus far the program has compared favorably.

Meteor Data



Conclusion

The photometric program we wrote appears to be successful at finding the calibrated magnitudes of events. There is some fine tweaking and optimization to be done, but after that, it is onto collecting enough data to statistically analyze and create our own population distribution of meteoroids.