Cooperative Balloon-Satellite Eclipse Measurement

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ABSTRACT

Six high altitude balloon payloads were built and flown in the path of totality on during the 2017 total solar eclipse across the US. The payload flight controllers consisted of Raspberry Pi computers running code written in Bash and Python 3.4 to collect and store data from sensors. The program on each payload collected data from an external temperature sensor, an internal temperature sensor, a pressure sensor, a light sensor, a GPS unit, and a camera. The design also incorporated a smart internal heater to prevent the payload from freezing. The payload design, circuit, and code will be presented along with lessons learned and plans for future work.

Data Collected

Below are scatter plots of the voltage data collected by the light sensors and the outside thermocouples by sample number. Measurements were taken approximately once per second for the durations of each flight, respectively. Due to time restrictions, the light sensor calibration was recorded, but not included in the program.

Analysis and correlation of the data is ongoing, but the light data will be compared to a relationship of two disks overlapping, and the temperature data will be compared to common models and previously collected data.

Set-up

The Raspberry Pi was connected by a 40p ribbon cable to the circuit board, which connected the sensors, battery power, heater, analog-to-digital converter chip, the start button, and the indicator LED. The camera and GPS were attached by their own cables, respectively.

Payload Pictures

A view of the edge of totality from payload #2 over Fulton, MO
A view from within totality from payload #4 over Mitchell, NE
A picture from payload #3 near apex over Moneta, WY
A view of the edge of totality from payload #2 over Fulton, MO

Future Revisions

In future iterations of the payload design, modifications could be made to correct the following problems:

- The GPS is limited by altitude.
- Data from each sensor was recorded to its own respective file with non-standard timestamps. These both make processing inconvenient.

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