

LUNAR IMPACT OBSERVING

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Abstract:

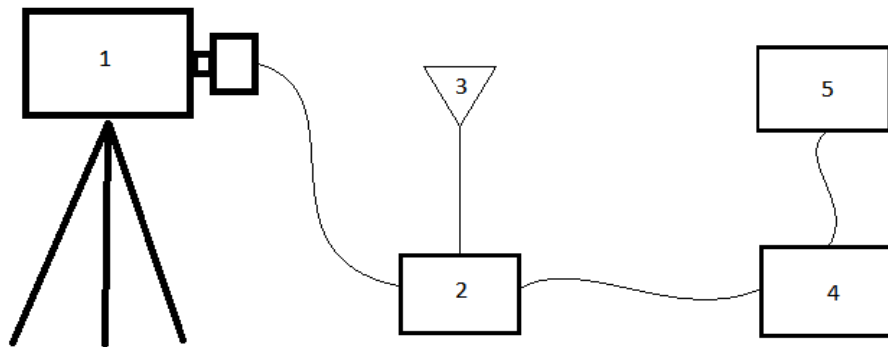
The members of University of North Alabama's (UNA) Chapter of Society of Physics used video camera recordings to observe meteor impacts on the lunar surface. This will in part support National Aeronautics and Space Administration's (NASA) Lunar Impact Monitoring Program to better understand the environment in space.

Introduction:

When a meteor impacts the moon, the energy release causes a very brief flash of light bright enough to be visible from the Earth. Observing these impacts is of great importance to NASA to assess threats to equipment and personnel in space. The observations will help NASA and in turn, the world better understand the lunar environment and similar planetary bodies.

Equipment/Setup:

The UNA observatory was utilized as the main location for conducting the research. UNA's planetarium houses a Celestron 0.36m telescope which was used for the observations. The 0.36m telescope is mounted on a Losmandy Titan equatorial mount. The software, LunarScan, was used for detecting the impact flashes. With the award, we purchased a Watec 902H2 ultimate CCD camera, Canopus ADVC 110 Digitizer, Intuitive Circuits GeoStamp+ GPS time inserter, TPO 1.25' focal reducer and C/CS mount adapter. We needed a camera that captures at least 30 frames per second to detect the flash of the impact which only lasts a couple frames at that rate. The setup is shown below.



Legend:

1. Telescope, focal reducer and camera 2. GPS overlay 3. GPS receiver
4. Digitizer 5. Laptop

Figure 1: Equipment Setup - The telescope, focal reducer, and camera create the image signal, the gps overlay embeds the gps time on the image, the gps receiver grabs the gps time signal, the digitizer converts the signal, and the laptop allows us to see the image.

Method:

First, we had to collect data. We connected the camera and focal reducer to the telescope. The signal from the camera was sent to the GPS overlay. The external GPS receiver was placed near the telescope mount, so it was in line of sight of the sky to get a GPS signal and was connected to the overlay unit. The GPS overlay imprinted the universal time and date on the image. This video was sent to the digitizer, which converted the signal into a digital signal for the laptop. We aimed the telescope at the moon and turned the mount motor on and set it to track the sky. The tracking software was not designed for our purpose, so we had to check the laptop periodically to ensure we were still on target. We used mount's fine adjustment paddle to keep the telescope pointed at the moon. After we were on target, we started the capture with WinDV program on the laptop. The software captured video at the desired 30 frames per second and into 12.5 minute segments to keep the file size manageable.

Secondly, we had to analyze the data. We put each 12.5 minute segment into LunarScan software to detect and bright flashes on the images. The software analyzes each frame for a bright flash. After the program checks the entire segment, we had to verify each possible impact. The program displays a 21 frame movie loop and each still frame to verify the flash. At this point if we still think it is an impact, we use the software to extract the image of the flash; the software outputs a negative still frame of the brightest flash and a second image of a zoomed in on the spot of the 3 preceding frames, the brightest frame and the 3 following frames also negatives shown below.

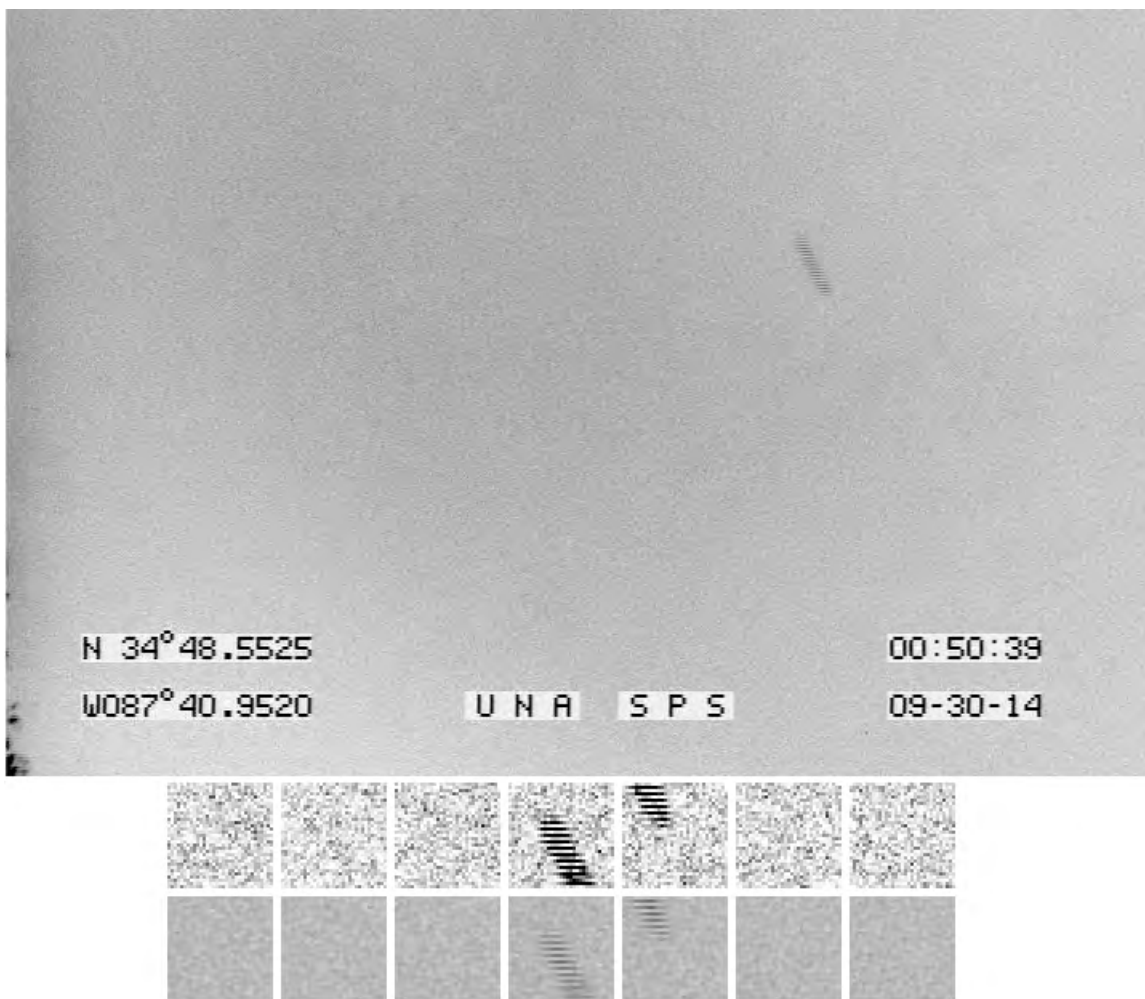


Figure 2: LunarScan Output Images: The top image displays the single frame. The bottom image shows the 7 frame sequence zoomed in on the area of impact. This image is most likely a satellite in orbit.

If it is a large impact, the frames will display the light curve, which is used to determine the size of the object. If we think it is an impact, we send the data to NASA to be verified by other observers.

Results:

We captured 5.5 hours of footage over the 4 months we had all of the equipment setup. Seeing as we were observing the dark side of the moon, we were limited in observing when the visible side of the moon is illuminated between 10-50%. Since the moonrise and moonset time vary, we were limited to only a few observation opportunities every 2 weeks. These viewing times were further constricted by weather and schedules of the students involved. However, we were able to catch almost all available viewing times aside from the times restricted by weather, due to the large number of people interested in the project. Out of the people that expressed interest and helped in other ways, 7 of the students actively engaged in collecting data during observation times, all of which are members of the national Society of Physics Students. Out of all the possible viewing times, there was only one confirmed impact posted by NASA. We think it was out of frame, since we did not detect a flash at that time. We did have roughly 5 flashes per segment to verify, but none appeared to be an impact. Most were most likely cosmic rays detected by the camera and we collected a nice clip of a satellite passing by, one of the images displayed above.

The Future:

Now that the planetarium has the new equipment, the SPS can continue supporting the lunar impact monitoring program as well as other, similar projects.

References:

- (1) Lunar Impacts: http://www.nasa.gov/centers/marshall/news/lunar/program_overview.html

Impact Assessment:

The project was very fun. It afforded the chapter the opportunity to work on something together, and it was a larger project that attracted more people in the club, allowing more people to bond and work on something together, strengthening the club as a whole.

There were some hiccups allocations ordering the exact items we requested. We were advised to budget on the high end. This was the project's saving grace. There was enough extra allotted to cover the extra cost of the more expensive items we had to order instead of the items requested. We ended up being very slightly over budget because of this, but the extra couple of dollars was covered by the planetarium's account.

We plan to continue this project. Once we have data of an actual impact, we hope to present the data as a poster at a conference.