Remote Sensing Activity: Physics from a Rocket-Borne Video Camera

First viewing of the video:

The videos are at http://physics.bgsu.edu/~layden/AstroCam/astrocam_phys.htm

If your browser opens the movie with Quick Time Player, you can scroll forward/backward by dragging the slider, you can go frame by frame by clicking on the slider and using the left/right arrow keys. This provides precise control and measurement.

Our trigonometry: **tan A = s / d** (solve it for whichever variable you seek).

Day 1: Find a good frame that allows you to see both the known-sized, on-the-ground markers and some unknown-sized object.

- (i) Use the known-sized object to determine the height of the rocket (*d*),
- (ii) To complete (i), you will need to calibrate: use one of the scaleNm.avi videos to help you work out the angular size of the rocket's field of view, A_{fov}.
- (iii) Then use the unknown-sized object along with *d* to determine the size of the unknown object (*s*) – like a spacecraft's "remote sensing" mode.
- (iv) If you have time, confirm your value of *d* by measuring one or more other known-sized, on-the-ground objects on your frame.
- (v) If you have time, use known-sized, on-the-ground objects to find the peak height the rocket obtained in its arcing path (as late in the movie as you can).

Day 2: Find a good sequence of frames (at least 3 frames, preferably 5 or more) that allow you to see the known-sized, on-the-ground markers. Closer to the ground gives better results.

- (i) Use the known-sized object to determine the height of the rocket (*d*) on each frame, and the difference in distances ($\Delta d = d_2 - d_1$) between frame pairs.
- (ii) To complete (i), you will need to calibrate: use the video of the clock to determine the amount of time passing between each frame; this is Δt.
- (iii) Compute the velocity, $v = \Delta d / \Delta t$, between adjacent pairs of frames. You should get at least two velocity measurements.
- (iv) Compute the acceleration between pairs of velocity measurements, $a = \Delta v / \Delta t$. Compare your result to the acceleration of a freely falling object, 9.8 m/s^2.
- (v) Use the "graph paper" on page 2 to plot the distance as a function of time (*d* vs. *t*) and velocity as a function of time (*v* vs. *t*) for your sequence of measurements. What do you conclude from the plot?
- (vi) Organize your thoughts so we can share results verbally, discuss strengths and weaknesses, and identify other things to measure in the videos.

-- Developed by Andrew Layden, BGSU Physics & Astronomy, July 2010.

