Analysing data from the Apollo 11 mission to the Moon

A large-scale experiment in space

Detailed data are kept of every space flight. These data, giving speeds and distances of Apollo 11 as it went to and returned from the Moon, are extracted from data supplied by NASA. They can be thought of as the results of an experiment to probe Earth’s gravitational field.

You will need

* computer running a spreadsheet
* spreadsheet data table

Finding the gravitational field at different distances

The spreadsheet just provides raw data. To get information from it you will have to select and process data from it.

The flight data have a number of values of velocity and distance, arranged in pairs measured 10 minutes (600 seconds) apart. You can see how far Apollo 11 travelled in 10 minutes. You can see that Apollo 11 is decelerating on the way out and accelerating on the way home. You can find the acceleration and so the gravitational field at different distances:

1. Calculate the changes in velocity between each pair of distances.

2. Calculate the average distance for each pair.

3. Calculate the average acceleration at each distance, from the change in velocity and the time interval (600 s).

4. Plot one or more graphs to test whether the acceleration varies as the inverse square of the distance. Take trouble to find the graphs which best tell the message in these data. Give the graphs a caption saying what they have to tell.

Warning: the velocities given point approximately away from the centre of the Earth, but the space flight does change direction. So a simple calculation of the acceleration is only roughly an indication of the Earth’s gravitational field at that point.