FARSIDE LUNAR GRAVITY FROM A MASS POINT MODEL, Mohan Ananda, Jet Propulsion Laboratory, Pasadena, Calif., 91103

A mass point representation of the lunar gravity field was used and a field was determined from the long periodic orbital variations of the Apollo 15 and 16 subsatellites data. A radial acceleration contour map, evaluated at 100 km altitude from the lunar surface, shows that the near side is in close agreement with the result derived from the line-of-sight method by Muller and Sjogren.(1) The farside map shows the highland regions as broad positive gravity areas and the basins such as Korolev, Hertzsprung, Moscoviense, Mendeleev and Tsiolkovsky as localized, negative gravity regions (consistent with Ferrari(2)).

The data set used in this analysis consisted of mean orbital elements rates ($\dot{e}, \dot{i}, \dot{\omega}$, and $\dot{\Omega}$) of the Apollo subsatellites. The mean elements were obtained by averaging the osculating elements, which were generated by fitting the raw doppler tracking data over one orbital period. The data were corrected for all non-lunar gravity perturbations, such as earth and sun and solar pressure effects. The data were also adjusted for the second harmonic of the gravity field (J_2).

In analyzing 60 days of Apollo 15 subsatellite data and 34 days of Apollo 16 subsatellite data, estimates of 127 mass points were obtained. Each mass point was placed about 12 to 18 degrees apart ($\approx$ 450 km) over the region of $\pm 30^\circ$ about the equator and 50 km below the lunar surface. Different sets of mass points solutions (115, 117, 121 masses) were generated from the data. Some of the mass points from the original set (127) were removed in order to reduce correlations.

Radial accelerations maps, evaluated at 100 km altitude from the lunar surface, for the different sets of mass points solutions have been generated. The general shape of the contours remain about the same in all the maps thus giving confidence in the solutions. The near side is in close agreement with the result derived from the line-of-sight method. The farside map has a 1st order agreement with the result derived from the harmonic field method(2). The farside highland regions seem to be as positive and the basins as localized negative areas. An interesting characteristic of the lunar gravity map from the mass points analysis is that the near side is almost all negative gravity regions except for the known positive mass anomaly basins and the farside is almost all positive gravity regions except for some localized negative areas near the basins. The farside map, by the harmonic field analysis, shows alternating high positive and high negative regions; this behavior is not seen in the farside map from the mass points analysis.

Studies also have been done by fixing the near side known mass anomalies and solving for the rest of the mass points. The acceleration map for the farside remains virtually unchanged. The near side and far side maps shown here are obtained by fixing 9 known mass points and solving for 112 mass points. Similar analysis by varying the number of mass points to be solved and also by varying the location of mass points is continuing. Combining a low order spherical harmonic gravity field and point masses is also being attempted.

1. Muller, P.M. and Sjogren, W. L., 1968 Science 161, 680-684.

2. Ferrari, A., Science (to be published)

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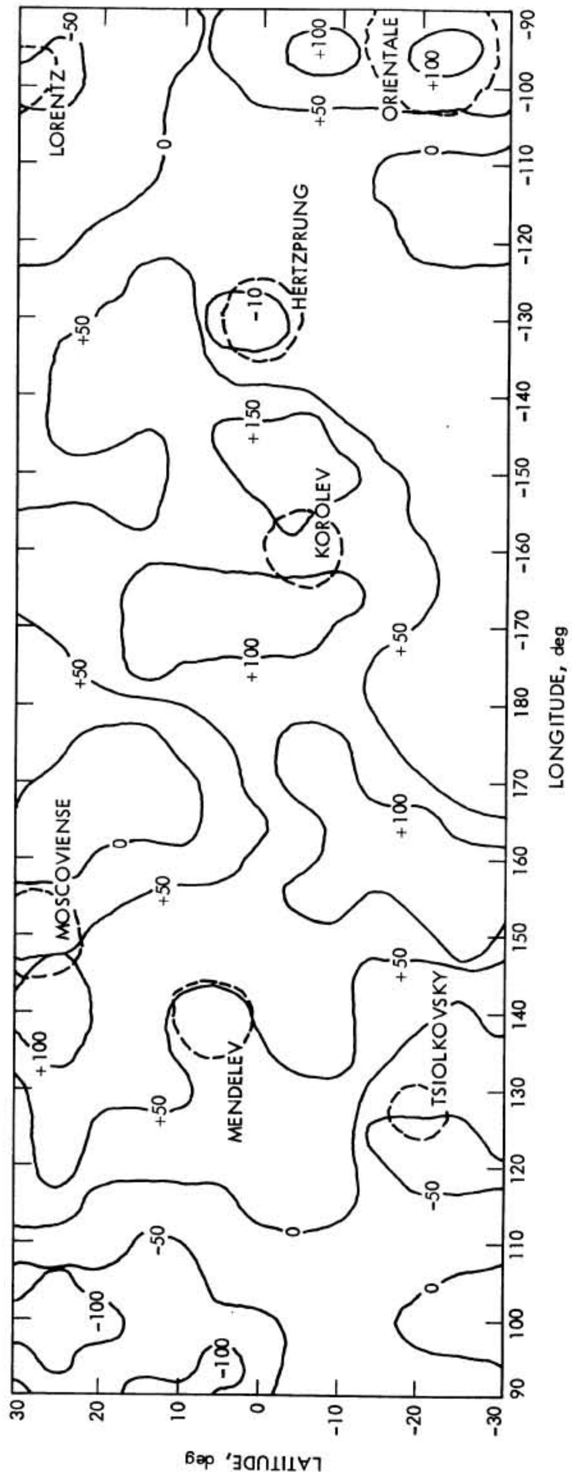

LUNAR GRAVITY: RADIAL ACCELERATION CONTOUR MAP
FAR SIDE

FARSIDE LUNAR GRAVITY FROM A MASS POINT MODEL

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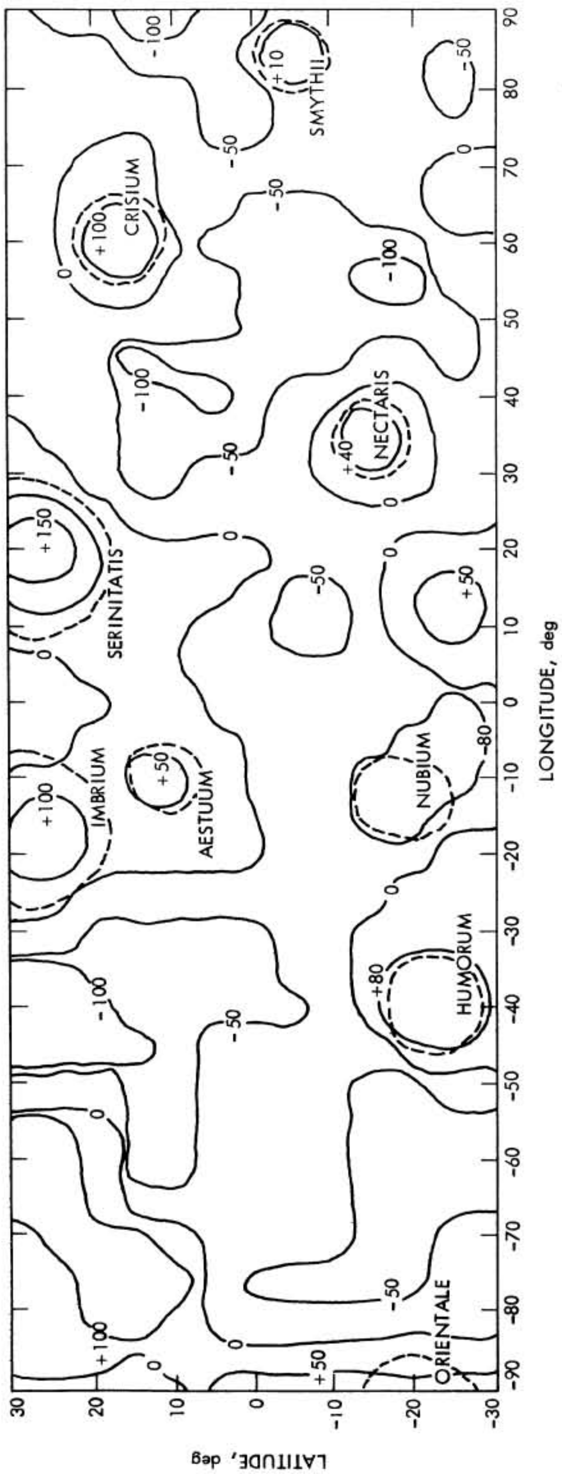

LUNAR GRAVITY: RADIAL ACCELERATION CONTOUR MAP
NEAR SIDE