MAPPING EXPERIMENT WITH SPACE STATION

Sherman S. C. Wu, United States Geological Survey, Flagstaff, AZ 86001 USA

Mapping the Earth from space stations can be approached in two areas. One is to collect gravity data for defining a new topographic datum using Earth's gravity field in terms of spherical harmonics. The geoid produced by this experiment may be much closer to the reality of Earth's equipotential surface than that which is currently used. Due to the fact that the Earth is both longitudially and latitudially asymmetric as indicated in the results of gravity studies by Votila (1962), this proposed experiment may be useful for a new generation of Earth mapping. The other, which should be considered as very significant contribution from the space station, is to search and explore techniques of mapping Earth's topography using either optical or radar images with or without reference to ground control points. Without ground control points, an integrated camera system can be designed. The system, in addition to the imaging camera, will consist of a stellar camera, radar altimeter and an inertial platform such as the one which was installed on the AN/USQ-28 Mapping and Survey Subsystem (Livingston et al., 1980). With ground control points, the position of the space station (camera station) can be precisely determined at any instant. Therefore, terrestrial topography can be precisely mapped either by conventional photogrammetric methods or by current digital technology of image correlation.

At an altitude of 300 km, the space station can view an area on the surface of Earth, that is intersected by a cone with a solid angle of 34.5° with respect to the Earth's center. Theoretically, if a total of 44 permanent ground-control points can be ideally distributed on the Earth's surface such that: 12 points along the equator with longitude increment of 30°; 18 points along latitude + and - 30° with longitude increment of 40°; 12 points along latitude + and - 60° with longitude increment of 60°; and 1 point at each of the two poles, then at least 3 ground control points can be viewed by the space station at any instant and its position (camera station) can be determined by resection with electronic ranging measurements. But, practically, permanent ground-control points in oceans are difficult to be established, distribution of permanent control points have to be adjusted on continents and islands. Geodetic position of ground control points can be predetermined by the Global Positioning System (GPS). In order to continue the radar experiment of the planned SIR-C mission, corner reflectors of right-angle tetrahedron can be installed at all ground control points.

With a radar altimeter on board, profiles traced along tracks of the space station can be utilized for constraints in addition to the determined position of the space station for photogrammetric processing.

For the mapping experiment with the space station, I propose to establish four such ground control points either in North America or Africa (including the Sahara desert). If this experiment should be successuflly accomplished, it may also be applied to our defense charting systems.

Sherman S. C Wu

References

Livingston, G., C. E. Berndsen, R. Ondrejka, R. M. Spriggs, L. J. Kosofsky, D. V. Steenburgh, and C. Norton, 1980, Aerial cameras, in Manual of Photogrammetry, 4th Edition, American Society of Photogrammetry, P. 187-287.

Votila, U. A., 1962, Harmonic analysis of world-wide gravity material: Suamalainen Tiedeakatemeia, Hersinki, 24 p.