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APPLICATIONS OF SATELLITE-TO-SATELLITE TRACKING TO ORBIT DETERMINATION AND GEOPOTENTIAL RECOVERY

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Recent simulations have demonstrated the applicability of satellite-to-satellite tracking data to the related problems of orbit determination and geopotential recovery. Specifically, satellite-to-satellite tracking between an earth orbiting satellite and a satellite at geosynchronous altitude (36000 km) produces long continuous data arcs which are not available by means of ground-based tracking. This facility, in conjunction with correct estimation techniques, can yield exceptional orbit determination accuracy. The data type also has considerable applicability to geopotential determination when the low satellite has a high inclination.

ORBIT DETERMINATION APPLICATIONS OF SATELLITE-TO-SATELLITE TRACKING

Attention is focused on the difficult problem of determining GEOS-C altitude with an average accuracy of 1 m. Error sources considered were ground-station survey error, data bias, epoch state errors for the high and low satellite, errors in spherical harmonic coefficients of the geopotential field to degree, and order 8. Standard covariance analysis software was utilized to determine that survey error and data bias were insignificant error sources, but that uncertainty in relay satellite state caused radial errors of the order of 100 m. Geopotential uncertainty caused an average radial error of 6 m. When the high and the low satellites are estimated and other error sources ignored, the average radial error is 6.2 meters. To identify the geopotential terms to be estimated in order to satisfy the constraint of 1 meter altitude resolution, a recursive procedure is implemented. If N-dominant geopotential terms along with GEOS-C and ATS-6 satellite states are estimated, and if the 1 meter radial error constraint is not satisfied, the geopotential term from among the unadjusted set which causes maximum radial aliasing is added to the estimated set of parameters. If the constraint is still unsatisfied, the recursive procedure continues. This recursive procedure has been automated within the covariance analysis software. The result of the procedure when applied to the GEOS-C orbit determination problem is that after 31 dominant geopotential terms are recursively identified and added to the estimated state along with GEOS-C and ATS-6 state, an average radial error of 1 meter is achieved.

GEOPOTENTIAL RECOVERY APPLICATIONS

During the GEOS-C mission it is planned to track GEOS-C from ATS-6 from widely separated geosynchronous positions of 94°W and 34°E. The resultant data set should be almost globally distributed. Simulations demonstrate that it is possible to estimate from this data set coefficients of the spherical harmonic representation of the geopotential field to degree and order 8 with an accuracy on an order of magnitude superior to that presently obtainable.