CONSOLIDATED LASER RANGING PREDICTION FORMAT: FIELD TESTS

Article · January 2004

CITATIONS
25

READS
243

1 author:

Randall L. Ricklefs
University of Texas at Austin
48 PUBLICATIONS **866** CITATIONS

SEE PROFILE

CONSOLIDATED LASER RANGING PREDICTION FORMAT: FIELD TESTS

R. Ricklefs
Center for Space Research, The University of Texas at Austin
ricklefs@csr.utexas.edu /Fax: 1-512-471-3570

Abstract

The new International Laser Ranging Service (ILRS) consolidated ranging target prediction format has been developed by the ILRS Prediction Formats Study Group to provide a single format to encompass traditional artificial satellite and lunar ranging targets as well as proposed transponder targets on or around the moon and other planets. The primary benefit will be to allow any ranging station convenient access to ranging any of these target categories. In addition, the new format is designed so that predictions will not be subject to the inaccuracies inherent in tuning to a specific gravitational or drag model as found in the current IRV format.

While details of a few extensions to the format remain to be worked out, the core lunar and satellite components of the format are stable and have been subjected to a pilot study at the McDonald Laser Ranging Stations (MLRS). A discussion of the sources for the new predictions is presented, as is an analysis of the results of the ranging tests. Plans for future tests and implementation are also discussed.

Introduction

The Consolidated Prediction Format (CPF) provides a method of ranging to disparate targets using one format. [1] This allows cross-technique ranging attempts. A lunar-only station can then easily try to range a satellite or transponders target. An SLR-only station can perform feasibility tests on the moon. When a new deep-space satellite is launched, there are 40 stations around the world that should be able to track and possibly range to it.

Some additional advantages of the new format are that it does not rely on on-site gravity model, tuning, or separate drag and time bias functions. It is a tabular format containing un-tuned state vectors at time intervals appropriate to the target. The state vectors are typically in true body fixed system of date.

Purpose of Field Tests

Field tests have begun for the purpose of demonstrating the new format. The tests are necessary to verify that nothing has been forgotten, either in the data fields or in the overall concepts. The tests also give an opportunity to assess the performance of the predictions in some of the various configurations – low and high earth satellites as well as lunar reflectors, and, eventually, transponders.

There will inevitably be some bottlenecks, confusion, and mis-steps in producing and handling the predictions. Tests with a small number of stations will allow these to be identified and corrected before the entire network is involved.

A side-effect of the tests will be the building of infrastructure for network implementation. As various prediction centers and stations come into the tests, the

distribution network will be put into place and shaken out.

MLRS Field Tests

To begin field testing, MLRS has taken a multi-faceted approach. To track satellite targets, HTSI Tuned Inter-range Vectors (TIVs) [2] are numerically integrated to produce one-minute state vectors which are then converted into the new format. This provides an easy way to start testing, using existing data products and provides a way to check out real-time point angles and ranges against existing software and predictions. The NERC Space Geodetic Facility (NSGF) tabular predictions are also being evaluated for use in the tests. For lunar ranging, the JPL DE-403 ephemeris is used as a basis for predictions produced in the new format.

Changes to the MLRS data acquisition software permit both old and new formats to be used, for quick switching during tests. This also minimizes maintaining nearly-duplicate versions of the code during the period prior to full switch-over to the new format.

Satellite and lunar normalpoint software does not currently use the new tabular format, due to development time constraints. The plan is to find time within the next few months to modify the normalpoint code so that it can use either the new or old format.

There have been no transponder tests, although Mars Global Surveyor predictions have been produced in the new format and verified to reproduce the original ephemeris to about 10 meters with the sample interpolation code. Hopefully, when Mercury Messenger returns in mid-2005, a number of stations will be able to track it using the new format.

Results

Preliminary code modifications are in place at MLRS, and predictions are available for internal tests. Data has been acquired on 4 satellite passes using the HTSI-derived predictions described above. At this time, the NSGF predicts are being evaluated. A couple of problems are delaying lunar tests, but those do not constitute major difficulties.

Conclusion

The fields tests are just starting at MLRS, and the results are encouraging, with passes being successfully tracked with the new format. LLR tracking with the new format should be tested soon. As time progresses, we expect more sources of predictions and more stations taking part in the tests.

Acknowledgements

Members of the ILRS Prediction Format Study Group have been involved in various phases of the field tests. To name 2, David Rowlands of Goddard Space Flight Center has provided Mars Global Surveyor predictions, and Graham Appleby of NSGF has provided satellite predictions in the CPF. We also wish to acknowledge funding for this project from NASA Contract NAS5-01096, NASA Grant NAG5-11464, and NSF Grant AST-0204127.

References

1. R. Ricklefs, “Consolidated Laser Ranging Prediction Format”, Proceedings of the Thirteenth International Workshop On Laser Ranging, Washington, D.C., October 2002.
2. “SLR IRV Format”, http://ilrs.gsfc.nasa.gov/products_formats_procedures/predictions/tirv_format.html.