III.3 SLR and LLR Coordination Centre

Introduction

The year 2000 has been a remarkable one for the Satellite Laser Ranging (SLR) and Lunar Laser Ranging (LLR) technique, since important contributions have been made for the generation of the ITRF2000 solution. In addition, the SLR/LLR community is heavily involved in an organizing process, with the aim of assuming a more coordinated role of the laser technique and providing for further improvements of the quality of results.

Activities in 2000

In principle, the SLR/LLR community has made contributions to the IERS in the same way as has been done in previous years. In general, three types of contributions can be distinguished:

(1) operational Earth Orientation Parameters
(2) final Earth Orientation Parameters
(3) station coordinates and velocities

The operational Earth Orientation Parameters (EOPs) are computed by a number of analysis institutes, and are submitted for inclusion in the IERS Bulletin A on a weekly or even more frequent basis. An overview of the various contributions as determined from the laser range technique is given in the table below. It is clearly visible that the frequency of the contributions, both in terms of number of submissions per week and in terms of length of data intervals, are diverse. At this moment, the same holds for the computation models and strategies and for the quality of the results.

Table 1. Overview of operational SLR/LLR EOP solutions.

institute	products	data interval per EOP solution [days]	submission frequency [days]
CSR	xpole, ypole, UT	3	7
DEOS	xpole, ypole	3	7
IAA	xpole, ypole, UT	1	1
MCC	xpole, ypole, UT	3	7

It is recognized, both by the IERS and the various SLR/LLR analysis groups, that the various products are not homogeneous. The International Laser Ranging Service (ILRS; cf. next section) will be instrumental in improving this situation.

Second, the various analysis institutes have contributed EOP solutions based on SLR/LLR observations for inclusion in the C04 series, which is a final EOP product produced by IERS. In some

cases these contributions are merely a merged set of operational EOP products, whereas other contributions were obtained from a full re-analysis.

The SLR/LLR technique has also contributed to the most recent model for station coordinates: ITRF2000. This model basically provides the position of a large number of stations at a certain reference epoch and the individual velocity of each station. In total, 10 SLR and 2 LLR solutions were included in the ITRF2000 solution, provided by the following institutes: AUSLIG, CGS, CLG, CRL, CSR (twice), DEOS, DGFI, GSFC and JCET (all SLR) and FESG and UTexas (LLR). For comparison, ITRF2000 also included 18 GPS solutions, 3 VLBI solutions, 3 DORIS solutions and 2 multi-technique solutions.

The SLR/LLR solutions played a very important role in the ITRF2000 solution. Because of the unique characteristics of the observations (the laser range measurements are absolute, and in principle unbiased), the technique is capable of providing absolute coordinates and velocities (at least for the north-south and vertical components; the east-west component is connected to the ascending node of the satellites and/or moon, and is therefore not 100% absolute), and also of determining the absolute scale of the network with unprecedented accuracy. In its computation of ITRF2000, the IERS has exploited this feature by having the ITRF2000 origin fully defined by the SLR/LLR solutions, and by having the latter contribute with 50% weight to the absolute scale of the network model (the other 50% of information was determined by the VLBI solutions). This choice clearly underlines the unique capabilities and role of the laser range technique, and illustrates its changing role in space geodetic investigations.

ILRS

The ILRS was established in 1998 in Deggendorf, Germany. Amongst others, the purpose of the ILRS is to coordinate the satellite missions using SLR and the tracking of these spacecraft, stimulate, improve and coordinate the analyses and, in general terms, promote the laser ranging technique as a whole. To this aim, the ILRS organization includes a Central Bureau, Analysis and Associate Analysis Centers, Data Centers, Operations Centers and Stations and Networks.

In addition, the ILRS has established 4 working groups, notably on

(1) Missions,
(2) Data Formats & Procedures,
(3) Networks & Engineering, and
(4) Analysis.

The total organization is headed by a Governing Board.

In principle, all ILRS elements affect the IERS, directly or indirectly. The most intensive interaction is with the analysis groups, of course, which are represented by the Analysis Working Group (AWG) and the Analysis Coordinator. The AWG is tasked with the coordination of the various analysis and research activities of the laser ranging community, and one of the direct goals is to develop a number of unique analysis products. To this aim, the AWG has defined a number of pilot projects, in essence all with the aim of improving the analysis products computed at individual research institutions. In addition, some of the pilot projects (on station coordinates and earth orientation, in particular) aim at the generation of unique analysis products. This is in line with the envisioned data and products flow of the IERS, following its reorganization in 2000.

To achieve the goals, the ILRS AWG has organized a number of workshops in which various analysis aspects are under discussion and in development. Specific items which are worth mentioning here are the interpretation and use of the SINEX format, the generation of test datasets with satellite observations, the definition of parameter representations, and the development of pilot projects.

The latter make use of specific test cases, and are instrumental in understanding the individual analysis products and the development of official combination products. The response from the SLR/LLR analysis community has been quite good, both in terms of attendance (about 15-20 analysts, typically) and in terms of number of contributions (about 10).

Ron Noomen, Bob E. Schutz, Peter J. Shelus