3.4.2 International Laser Ranging Service (ILRS)

Introduction

The International Laser Ranging Service (ILRS), established in 1998, is responsible for the coordination of SLR/LLR missions, technique development, operations, analysis and scientific interpretation. A number of these aspects will be discussed here briefly.

Network

The network of SLR/LLR stations has matured over the years. From a technical point of view, the single-shot precision of an average station has been reduced from about 20 mm in the mid-1990s to better than 10 mm currently; the best stations go well below that number. A similar observation applies for the absolute quality of the range measurements: thanks to progress being made both in technical aspects and in the modeling of various elements of the range equation (such as the troposphere effect, the satellite signature and such) the absolute accuracy of present-day SLR/LLR observations is better than 10 mm for a representative station, again with a large number of stations doing much better. Figure 1 shows the performance of the global network over the past several years. In particular, it shows the number of stations that have tracked either LAGEOS-1 or LAGEOS-2 in a specific year, plus the number of passes on these satellites (divided by 100 to make numbers fit better in one plot). The data yield on these two satellites can be considered as being representative for the acquisition of measurements on most of the other satellites that are equipped with retroreflectors. It is clearly visible that the number of stations has leveled off at slightly more than 40, whereas the production of passes (and, equivalently, normal points, or minutes of data) is still on the rise. The latter effect is due to improvements in technology, smarter operating techniques, automation, and such. However, the plot does not properly reflect the geometric distribution of the network, and changes therein. Unfortunately, the operation of the SLR station on Haleakala (Hawaii) had to be stopped in 2004 because of budgetary reasons. There also has been a hiatus for SLR operations in Arequipa, Peru. Also, the number of operating shifts of other (U.S.) stations had to be reduced for the same reason. As a consequence, a gap has arisen in the global coverage of stations, with reductions in the quality of particular SLR products and observing/validation capabilities.

Missions

SLR has supported many satellite missions over the years. In 2004, a total of 29 satellites (including the Moon) were being laser-tracked (cf. Table 1). During this year, there were two newcomers: Gravity Probe B, a relativity mission equiped with gyroscopes, launched in April 2004 and ICESat, a laser altimeter mission to monitor the ice fields in Antarctica and Greenland, in addition to sea surface and

atmospheric studies. Even though it was launched in 2003, ICESat has only become an active target in 2004, by a limited subset of stations of the worldwide SLR network. Clearly, this wealth of spacecraft customers may cause scheduling problems at individual stations (in particular when multiple satellites are in view of that station simultaneously). The general procedure applied to resolve this issue is the technique of so-called interleaving, where the telescope switches between satellites, and satellites at low altitudes (with short pass times) get highest priority.

Table 1: Overview of satellites (man-made and natural) that have been tracked routinely by the laser ranging network in 2004

Ajisai, Beacon-C, CHAMP, ENVISAT, ERS-2, Etalon-1, Etalon-2, GFO-1, Glonass-84, Glonass-86, Glonass-87, Glonass-88, Glonass-89, Gravity Probe B, GPS-35, GPS-36, GRACE-A, GRACE-B, ICESat, Jason, LAGEOS-1, LAGEOS-2, LARETS, Meteor-3M, Moon, Reflector, Starlette, Stella and TOPEX/ Poseidon.

Analysis

Of particular interest to IERS are the analysis products that the ILRS delivers. SLR plays a particularly important role in the assessment of the terrestrial reference system, since the laser technique provides unique information on the exact location of the Earth's geocenter and (shared with VLBI) absolute scale. Another area, where SLR plays an important role, is gravity field development. Although such solutions rely heavily on radiometric observations, the SLR measurements provide a unique tool to validate the orbital and gravity field solutions and independently assess their quality by virtue of their absolute, unbiased information content.

Specifically, the ILRS Analysis Working Group (AWG) coordinates the generation of a number of relevant data products. Since mid-2003, the AWG has been producing weekly time-series of solutions for station coordinates (and their derived parameters geocenter and scale) and Earth Orientation Parameters (EOPs; more specifically: x-pole and y-pole and excess Length of Day). After a test period of about one year, in which the length of the analysis intervals was modified and several fine-tuning modifications were made, the ILRS felt comfortable enough to label its products as "official ILRS". At this moment, 5 different analysis institutes (ASI/Italy, DGFI/Germany, GFZ/Germany, JCET/USA and NSGF/UK) deliver weekly solutions for global station coordinates and EOPs on Tuesday of each week. These solutions are based on SLR data taken on the satellites LAGEOS-1, LAGEOS-2, Etalon-1 and Etalon-2. Subsequently, these solutions are merged into a combination solution, which is done by ASI and DGFI. During the AWG

meeting in San Fernando (Spain) in mid-2004, ASI was “awarded” the name “official primary ILRS combination center”, and is hence the first responsible for the generation of combination solutions which go to various external customers such as IERS. Alternatively, DGFI was “awarded” as the official backup ILRS combination center, and must satisfy the same requirements on the combination product as ASI has to; in case of a failure at ASI of whatever kind, the DGFI product will be readily available to take the place of the primary product.

The combination solutions are used for a variety of purposes: the IERS Combination Pilot Project, the IERS/NOAA Bulletin A, etc. Recently, and at the request of IERS, the ILRS AWG has started a backprocessing of older SLR data in a similar fashion to serve as input for a successor to ITRF2000 and possible other applications.

The ILRS is confident that the unique characteristics of the SLR/LLR measurements and the resulting analysis products will (continue to) play an important role in current and future descriptions of specific aspects of System Earth.

Ron Noomen, Peter J. Shelus

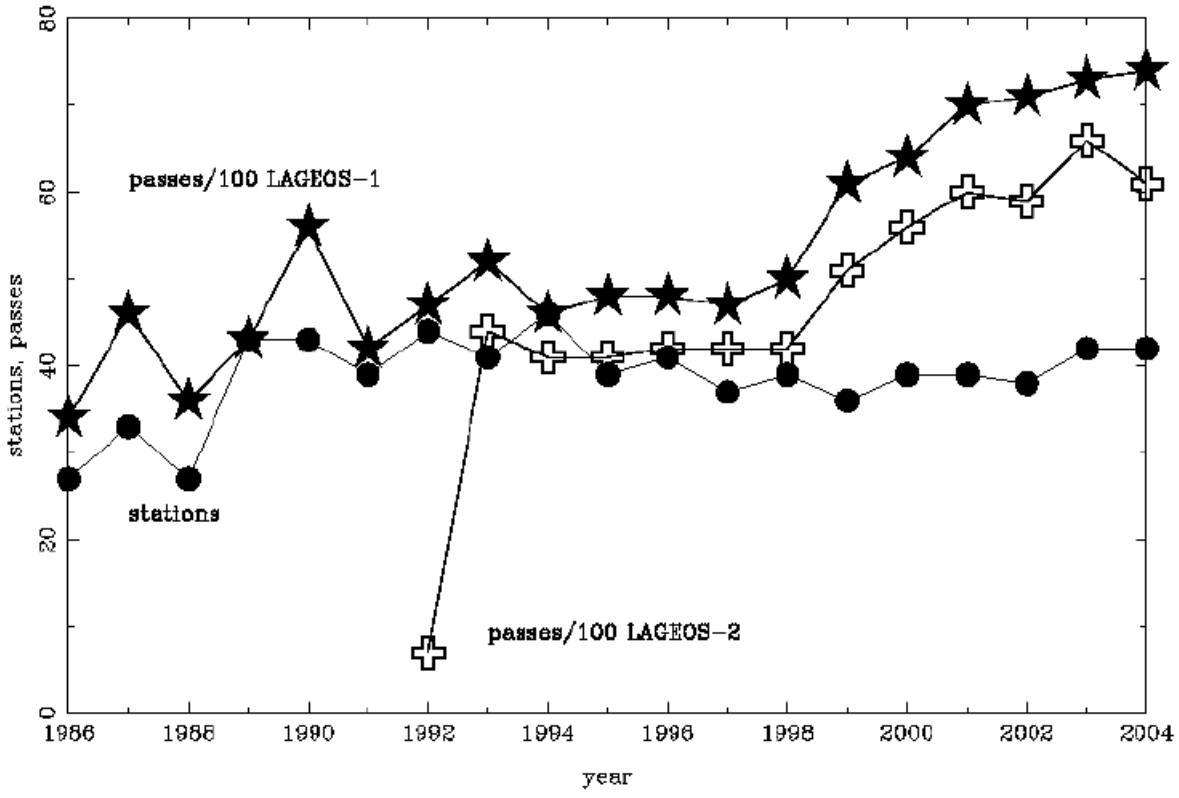

Fig. 1: Overview of tracking statistics on LAGEOS-1 and LAGEOS-2 of the global SLR network.