

3.6.2 Combination Research Centres

3.6.2.1 Agenzia Spaziale Italiana (ASI) – Centro di Geodesia Spaziale

Introduction The Matera ASI Space Geodesy Center (CGS) is a Fundamental Station, hosting three permanent Space Geodetic systems (SLR since 1983, VLBI since 1990, GPS since 1995) providing raw observation data, acquired, screened and archived continuously and then forwarded to the technique-dedicated organisations (ILRS, IVS, IGS). Since several years, besides the single-technique data analysis providing many geodetic products on routinely basis compliant with the needs from international geodetic organisations (ILRS, IVS, IGS, IERS) as Analysis Center (AC), ASI-CGS is involved in combination activities aiming to provide specific products and as well as to test combination methodologies; in particular, since June 2004, ASI-CGS is the primary ILRS Combination Center (ILRS CC).

Intra-technique combination research activity and products

The main lines of the ASI-CGS combination methodology rely on the direct combination of loose constrained solutions; this straightforward method (e.g. *“Methodology for global geodetic time series estimation: A new tool for geodynamics”*, P. Davies and G. Blewitt, JGR, vol. 105, no. B5, pages 11083–11100, May 10, 2000) allows handling input solutions easily, with no inversion problems for the solution variance-covariance matrix and no need to know a-priori values for the estimates. The reference frame is defined stochastically and is unknown; no relative rotation between the reference frames is estimated and removed. The combination is performed along the lines of the iterative Weighted Least Square technique, in which each contributing solution (and related variance-covariance matrix) plays the role of an ‘observation’ whose residuals with respect to the combined solution must be minimized; each solution is stacked using its full covariance matrix rescaled by a factor, computed at each iteration, fulfilling the conditions that the variance factor of the combination be close to unity and that each solution contribution be equally balanced. This loose combination methodology has been implemented and tested to handle site coordinates, site velocities, EOP, EOP rates coming from the same and/or different techniques.

1. Weekly contribution to ILRS “Pos+EOP” Pilot Project

At the end of 2002, the ILRS promoted a Pilot Project to set up an operational service able to provide each week, from individual contributing SLR solutions based on the observations to Lageos 1-2 and Etalon 1-2, an official ILRS set of combined:

1. weekly coordinates of the worldwide SLR tracking network;
2. daily EOPs (xpole, ypole, LOD), ITRF2000-framed for IERS Bulletin B.

ASI-CGS acts from June 2004 as primary ILRS Combination Centre, being in charge of providing weekly combined SLR solutions

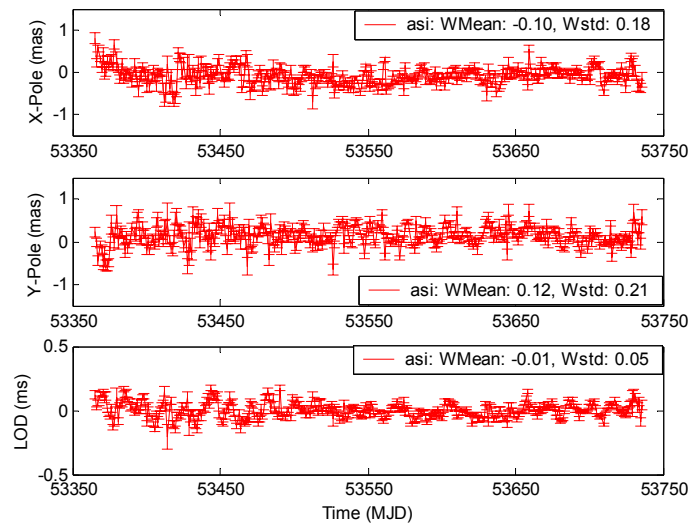


Fig. 1: ILRSA EOP differences w.r.t. IERS final values for 2005

available (labelled as 'ilrsa.pos+eop.yymmdd.v1.snx', SSC/EOP, and 'ilrsa.eop.yymmdd.v1', EOP only) to the users at the CDDIS and EDC archives. In Figure 1 the residuals of ILRSA EOP values w.r.t. the IERS final values are plotted.

2. Contribution to ITRF2005

ASI-CGS, as ILRS primary CC, applied the loose combination methodology 'backwards' also on the individual sets of weekly SLR solutions in the period 1993–2005 provided by the ILRS ACs in support of the ITRF2005 creation. The weekly combined solutions, labeled as 'ilrsa.pos+eop.yymmdd.v50.snx' and available at CDDIS and EDC archives, have shown a sub-centimeter agreement in the case of long-history, stable reference sites, once framed into ITRF2000.

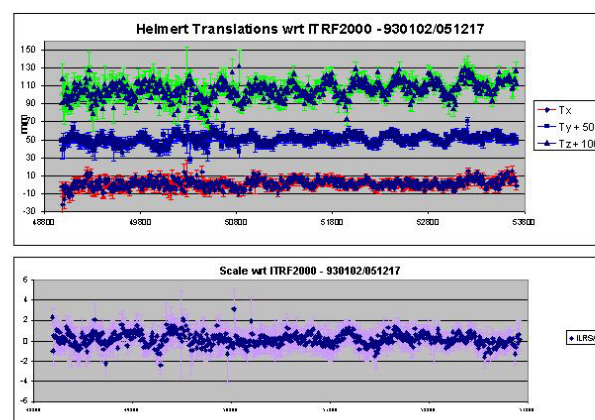


Fig. 2: ILRSA v50 contribution to ITRF2005

3. The API joint scientific group: a contribution to IERS Combination Pilot Project

API is a joint scientific group formed by ASI-CGS, Istituto Nazionale di Geofisica e Vulcanologia (INGV) and Politecnico di Milano (PoliMI) in order to study and develop geodetic inter-technique combination methods.

In 2005 the combination procedure used in the frame of ILRS “Pos+EOP” Pilot Project has been adapted to handle the intra-technique solutions in order to combine them. Local ties have been introduced as pseudo-observations in the loose constrained solution combination scheme. The inter-technique procedure is operational and satisfactorily preliminary results have been obtained.

4. Matera Geodetic Survey

In 2005 ASI-CGS has recomputed the Matera geodetic survey solution, including the IVP of the VLBI antenna modeled as ‘spindle torus’, with a renewed local data processing procedure, developed on site, designed to analyze data with a Weighted Least Square methodology using minimal inner constraints to avoid solution distortion. The local data have been taken during a dedicated survey measurement campaign in which corner cube reflectors have been placed on the antenna dish as in Figure 3.

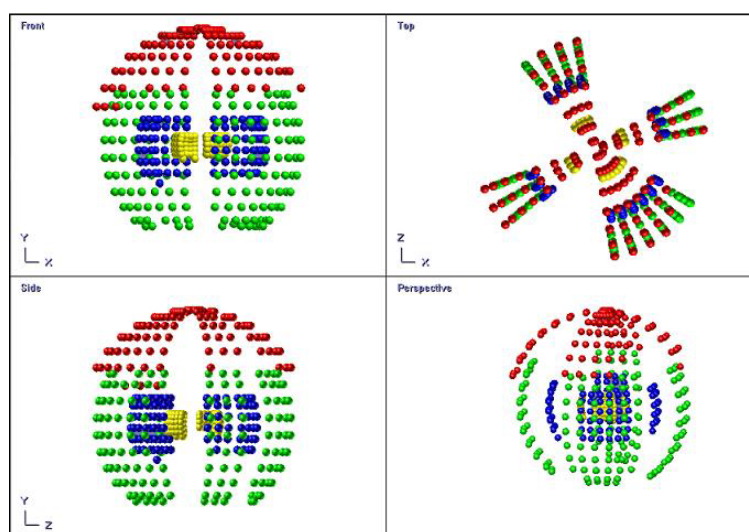


Fig. 3: Places of corner cube reflectors on the VLBI antenna dish during survey measurements

The new geodetic survey results have been provided to IERS and will be of key importance in the inter-technique combination to be performed in the ITRF2005 construction and in the IERS CPP.

*Giuseppe Bianco, Roberto Lanotte,
Vincenza Luceri, Cecilia Sciarretta*