Geophysical Research Abstracts
Vol. 15, EGU2013-3640, 2013
EGU General Assembly 2013

Three Corner Hat applied to the non-linear residuals of ITRF2008 station position time series: a critical analysis

Claudio Abbondanza (1), Toshio Chin (1), Richard Gross (1), Michael Heflin (1), Jay Parker (1), Xiaoping Wu (1), and Zuheir Altamimi (2)

(1) Jet Propulsion Laboratory, California Institute of Technology, Pasadena (CA), USA (claudio.abbondanza@jpl.nasa.gov), (2) Institut National de l'Information Géographique et Forestière, Laboratoire de recherches en Géodésie, Université Paris Diderot, Paris, France

Evaluating the uncertainty of VLBI, GPS, SLR and DORIS is a key factor for an optimal combination of terrestrial reference frames (TRF). In the current ITRF, the uncertainty assessment of the 4 space-geodetic (SG) techniques relies on the analysis of the non-linear residuals stemming from the stacking procedure.
Statistics based on the post-fit residuals (e.g. a posteriori variance factor, repeatability) are commonly adopted as metrics apt to quantify the intrinsic precision of the single techniques and to scale the covariance matrices of the stacked reference frames.
As an alternative to such intrinsic metrics, the Three Corner Hat (TCH) can be applied to non-linear residuals of station position time series at ITRF co-locations with the aim of quantifying the inter-technique (relative) precision and suitably scaling the covariance information in the combination.
TCH aims to quantify the variance of the noise process related to each SG technique assuming an additive-noise model for the station position time series $x_i(t) = s(t) + w_i(t)$, where $s(t)$ identifies a common signal and $w_i(t)$ is a zero-mean white noise process denoting the measurement error for the i-th technique. Also, TCH requires the $w_i(t)$ of the four techniques be uncorrelated.
If, on the one hand, the absence of correlation among the $w_i(t)$ is generally verified, the assumption of the standard additive model for describing the station position time series appears to be over-simplistic. In fact, previous studies focusing on the geodetic positioning consistently showed that non-linear residuals of station positions can be decomposed into seasonal harmonics (i.e. loading signal), technique-dependent systematic errors and a background noise better described by a combination of flicker and white noise. Systematic errors affecting geodetic positioning are clearly evident in GPS and DORIS time series and most likely related to draconitic signatures. If ignored in the TCH analyses, such systematics can contaminate the estimates of the inter-technique precisions.
In this investigation, TCH is applied to the data set adopted for the ITRF08 realization: GPS, DORIS, VLBI and SLR solutions have been re-analyzed in order to obtain comparable non-linear-residual time series of center-of-figure-related station positions at ITRF co-locations.
Spectral analyses of the time series confirm the presence of pervasive draconitic signatures for GPS and DORIS and suggest that VLBI is most likely the only technique for which the assumption of pure Gaussian background noise is acceptable.
To evaluate the applicability of the TCH when colored noise and systematics affect the geodetic positioning, we simulate time series of station positions accounting for *(i)* the noise content, *(ii)* the systematics and *(iii)* the dissimilar performances of the different SG techniques. TCH is applied to the simulated time series and the presence of systematics errors and the effect of non-gaussianity of the measurement process on the relative precisions are discussed and quantified.