SOURCE POSITIONS TIME SERIES GENERATION AND ANALYSIS

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ABSTRACT. Time series for more than 600 sources were calculated with using QUASAR software from VLBI data processing. Source positions for every sources were obtained from single series analysis by two ways - with fixed coordinates of all another sources with and without EOP estimation.Time series analysis is performed with covariation analysis technique. The attempt was made to propose the parameter which can be used for selection of stable and unstable sources from analysis of source positions time series.

The main goal of this study is to propose the parameter which can be used for selection of stable and unstable sources from analysis of source positions time series. We suppose that white noise in source position time series mostly appears from the instrumental effects and thus the only variance is not good characteristic of source stability. We calculate the covariance function for time series and try to use second point of it as the characteristic parameter. Its value shows ho much the time series was correlated and does not matter that way it was correlated the random walk or piece-wise linear or some else.

Source positions time series iaa000b, iaa000c were calculated with using the software QUASAR created in IAA RAS in 2002 (Gubanov V. at all, 2002) and developed further in 2004-2006 (Gubanov V. at all, 2004, Gubanov V., 2004, Kurdubov S., 2007)). Most available VLBI observations (excluding DSN and VCS sessions) since August 1979 to May 2007 were used. Time series were generated from single session solution for every sources: one source for the session, coordinates of all another sources were fixed. Station positions were not estimated for both series. TRF was fixed by ITRF2005, CRF was fixed by ICRF-Ext.2(A. Fey¡ 2004). The next parameters were estimated in this solutions: position of one source, EOP (X_p,Y_p,UT1–UTC,X_c,Y_c)(only for iaa000b solution), WZD (linear trend and stochastic), troposphere gradient east and north, station clock offset (quadratic trend and stochastic).

We use the covariance function for analysis obtained time series. Because there are no conventional algorithm for obtaining covariance functions of non equidistant time series we use the follows two methods:

First method

For non equidistant time series:

$$\{x_i\}_{i=1}^{N},\ x_i = x(t_i),\ t_1 < t_2 < ... < t_N,\ i = 1, ..., N. \tag{1}$$

Estimation of the covariance function for equidistant time shifts:

$$\tau_k = \Delta\tau \cdot k,\ \Delta\tau = \frac{t_N - t_1}{M}, k = 0, ..., M-1,\ M < N.$$

was calculated by formula

$$q(\tau_k) = \frac{M-k}{M}\left(\sum_{i,j:\tau_k<|\gamma_{ij}|<\tau_{k+1}} x_i x_j\right)/m_k, k = 0, 1, ..., M-1.$$

here $\gamma_{ij} = t_i - t_j$, and m_k - number of γ_{ij} in the range from τ_k to τ_{k+1}. The $\Delta\tau$ was choosen 14 days.

Second method

Estimation of the covariance function q_k for not equidistant averaged time shifts τ_k:

$$q_k = \frac{\sum_{j=k+1}^{N-k} x_{k+j}x_j}{N},\ \ \tau_k = \frac{\sum_{j=k+1}^{N-k}(t_{k+j} - t_j)}{N-k},\ k = 0, 1, 2, ..., N-1. \tag{2}$$

By this ways we obtained covariance functions for all time series of all centers (these data will be available on the ftp server Next ICRF2 WG). The covariance functions for long time series were similar and in further computations we use the first one.

For the further analysis we use the values q_1 — the second point of covariance function. The first point q_0 is variance of the time series. But second point characterizes the variance of the correlated part in the time series.

We suppose that white noise in source position time series mostly appears from the instrumental effects and thus the only variance is not good characteristic of source stability. The second point of covariance function shows how much the time series are correlated and does not matter the origin of correlation the random walk or piece-wise linear or some else.

We calculate the coefficient $k = Max(q_1^{RA*cos(DE)}, q_1^{DE})$ for each time series and use it to apprise how much stable the sources is. In Table 1 are shown the most stable sources by this criteria ($k < 0.1$) and in Table 2 most unstable ($k > 0.5$). The 15 sources form Table 1 are presented in M. Feissel list of stable sources and 4 sources from Table 2 in unstable list.

Source	N_{sess}	k	Source	N_{sess}	k	Source	N_{sess}	k
1351-018	489	0.040	1255-316	121	0.078	1908-201	386	0.096
0111+021	109	0.048	1606+106	1854	0.082	0743+259	400	0.096
1128+385	955	0.049	1652+398	218	0.087	0642+449	937	0.096
2318+049	426	0.060	0556+238	385	0.089	0804+499	1115	0.096
0201+113	378	0.065	1417+385	173	0.091	0602+673	328	0.097
2209+236	139	0.068	1144+402	93	0.093	0749+540	630	0.098
0133+476	1027	0.076	0657+172	112	0.095			

Table 1: Most stable sources ($k < 0.1$)

Source	N_{sess}	k	Source	N_{sess}	k	Source	N_{sess}	k
0355+508	269	0.556	1354+195	78	0.688	1642+690	96	0.852
2128-123	558	0.573	1053+815	351	0.725	1253-055	140	1.212
1641+399	813	0.575	2007+777	224	0.777	0316+413	96	1.305
1226+023	709	0.581	1313-333	99	0.835			

Table 2: Most unstable sources ($k > 0.5$)

The main disadvantage of this method is that in can be applied only to the sources with at least hundred sessions.

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