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Analysis of temporal correlations in GPS time series: comparison between different methods

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Previous works (Agnew, 1992; Langbein et al., 1997; Zhang et al., 1997; Mao et al., 1999; Williams, 2003; Williams et al., 2004; Amiri-Simkoeii et al., 2007) have proved that the daily GPS time series are characterized by coloured noise. The Power Law Noise Process (PLNP) method has been generally adopted to describe the noise of continuous GPS observations. We suggest a different methodology to define the stochastic model of time series of position estimates for permanent GPS stations: when the residual data, after the linear and periodic trend reduction is performed, behave as a stationary and ergodic stochastic process, we suggest to define the noise characteristics of the GPS signal studying the Empirical Covariance Function (ECF).
In principle, whether the stationary condition is satisfied, the two methodologies, PNLP with the estimate of the fractional spectral index and ECF, should give the same results, because they face the correlation analysis problem by a dual point of view: frequency and time domain respectively. However, due to the long computational time especially for long time series, the PLNP model is often approximated by fixing the spectral index to the value of the flicker noise. In this case we think that the results obtained by means of the ECF method are more rigorous than those obtained by fixing the spectral index, because it reflects, via covariance estimation, the proper stochastic structure of the data. Moreover, the ECF method have no computational burden respect to PLNP method with fractional spectral index estimation.
The PLNP and ECF methodologies have been compared on a set of 70 Italian GPS stations, with variable observation windows, from a minimum of three years up to over 10 years.