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A new algorithm for automatic Outlier Detection in GPS Time Series

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Nowadays continuous GPS time series are considered a crucial product of GPS permanent networks, useful in many geo-science fields, such as active tectonics, seismology, crustal deformation and volcano monitoring (Altamimi et al. 2002, Elósegui et al. 2006, Aloisi et al. 2009). Although the GPS data elaboration software has increased in reliability, the time series are still affected by different kind of noise, from the intrinsic noise (e.g. thropospheric delay) to the un-modeled noise (e.g. cycle slips, satellite faults, parameters changing). Typically GPS Time Series present characteristic noise that is a linear combination of white noise and correlated colored noise, and this characteristic is fractal in the sense that is evident for every considered time scale or sampling rate. The un-modeled noise sources result in spikes, outliers and steps. These kind of errors can appreciably influence the estimation of velocities of the monitored sites. The outlier detection in generic time series is a widely treated problem in literature (Wei, 2005), while is not fully developed for the specific kind of GPS series.
We propose a robust automatic procedure for cleaning the GPS time series from the outliers and, especially for long daily series, steps due to strong seismic or volcanic events or merely instrumentation changing such as antenna and receiver upgrades. The procedure is basically divided in two steps: a first step for the colored noise reduction and a second step for outlier detection through adaptive series segmentation. Both algorithms present novel ideas and are nearly unsupervised. In particular, we propose an algorithm to estimate an autoregressive model for colored noise in GPS time series in order to subtract the effect of non Gaussian noise on the series. This step is useful for the subsequent step (i.e. adaptive segmentation) which requires the hypothesis of Gaussian noise. The proposed algorithms are tested in a benchmark case study and the results confirm that the algorithms are effective and reasonable.

Bibliography
- Aloisi M., A. Bonaccorso, F. Cannavò, S. Gambino, M. Mattia, G. Puglisi, E. Boschi, A new dyke intrusion style for the Mount Etna May 2008 eruption modelled through continuous tilt and GPS data, Terra Nova, Volume 21 Issue 4 , Pages 316 – 321, doi: 10.1111/j.1365-3121.2009.00889.x (August 2009)
- Altamimi Z., Sillard P., Boucher C., ITRF2000: A new release of the International Terrestrial Reference frame for earth science applications, J Geophys Res-Solid Earth, 107 (B10): art. no.-2214, (Oct 2002)
- Elósegui, P., J. L. Davis, D. Oberlander, R. Baena, and G. Ekström , Accuracy of high-rate GPS for seismology, Geophys. Res. Lett., 33, L11308, doi:10.1029/2006GL026065 (2006)
- Wei W. S., Time Series Analysis: Univariate and Multivariate Methods, Addison Wesley (2 edition), ISBN-10: 0321322169 (July, 2005)