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GPS TOOLBOX

GPS interactive time series analysis software

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Abstract Time series analysis is an important part of geodetic and geodynamic studies, especially when continuous GPS observations are used to explore areas with a low rate of deformation. In this domain, having precise and robust tools for processing and analyzing position time series is a prerequisite. To meet this requirement, a new software package called GPS Interactive Time Series Analysis was developed using the MATLAB language. Along with calculating basic statistics and quality parameters such as mean and variance, the software is capable of importing and visualizing different time series formats, determining and removing jumps and outliers, interpolating data, and producing numerical and publication quality graphical outputs. Furthermore, bivariate statistical analysis (such as correlation coefficients, curvilinear and nonlinear regression), residual analysis, and spectral analysis (such as auto-spectrum, Lomb–Scargle spectrum, evolutionary power spectrum, and wavelet power spectrum) form the main analysis features of the software.

Keywords GPS time series analysis · Jump detection · Regression analysis · Trend analysis · Spectral analysis · MATLAB

The GPS Tool Box is a column dedicated to highlighting algorithms and source code utilized by GPS engineers and scientists. If you have an interesting program or software package you would like to share with our readers, please pass it along; e-mail it to us at gpstoolbox@ngs.noaa.gov. To comment on any of the source code discussed here, or to download source code, visit our website at http://www.ngs.noaa.gov/gps-toolbox. This column is edited by Stephen Hilla, National Geodetic Survey, NOAA, Silver Spring, Maryland, and Mike Craymer, Geodetic Survey Division, Natural Resources Canada, Ottawa, Ontario, Canada.

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Introduction

Continuous GPS observations in the form of time series are often used to monitor crustal deformations. Depending on the nature of the signal and other contributing factors within the time series, various methods are required to distinguish signals originating from the tectonic displacement and the other non-tectonic signals such as seasonal variations. These methods can be used for the following: (1) visual interpretation such as spectrogram, wavelet power spectrum, and recurrence plots (Trauth 2010), (2) time series processing such as convolution and filtering, impulse, and frequency responses of filters, and (3) statistical analysis such as auto-spectral and cross-spectral analysis, interpolation and analysis of unevenly spaced data, evolutionary power spectrum, and wavelet power spectrum.

Several software programs are known to have been specifically developed or published freely and made available for the time series analysis, among them, GAMIT/GLOBK MATLAB® (GGMatlab) (Herring 2003), Create and Analyze Time Series (CATS) (Williams 2008), and iGPS (Tian 2011). Despite the good efforts done, more functionalities are still demanded for the time series analysis in Geodesy and Geodynamics studies. For example, tools for data spacing and interpolation, jump detection and removal, and spectral analysis, especially when the data are