IN SEARCH OF PERIODIC SIGNATURE IN THE IGS REPRO 1 SOLUTIONS

James Mtamakaya[1], Marcelo C. Santos[1] and Michael Craymer[2]

[1]Dept. of Geodesy and Geomatics Engineering, University of New Brunswick, Canada
[2]Geodetic Survey Division, Natural Resources Canada
{r774p@unb.ca; msantos@unb.ca; craymer@nrcan.gc.ca}

1. Introduction

The primary objective of this research is to investigate and identify for periodic signatures in the REPRO1 solutions, recently released by the IGS (IGSMAIL6136). At this stage, a selected sub-set of IGS station time series in position and residual domain are under harmonic analysis. From the position domain we can learn more about actual station motions and from the residual domain we can learn about mis-modelled or un-modelled errors.

We have investigated different possible error sources such as the tidal effects, atmospheric loading, and the position of the Earth rotation axis. This poster presents and discusses some of our findings.

2. Investigative tools and analysis

Least Squares Spectral Analysis (LSSA) is the main tool used in this analysis. LSSA can analyze data time series with known and unknown a-priori variance factor and handle un-equally spaced time series without a pre-processing requirement. LSSA can test the statistical significance of spectral peaks in the spectrum. It is based on the developments by Vaníček [1969, 1971] and later improvements by [Wells et al., 1985] and [Pagiatakis, 1998]. LSSA was later on extended to least-squares product spectrum to define a new probability distribution function and new confidence level above which product spectrum peaks are statistically significant [Pagiatakis et al., 2007].

3. Implementation and results

A global LSSA case study has been developed and implemented based on 16 years IGS data (1994 to 2010) data from unequally spaced vertical and horizontal component of weekly coordinate time series and residuals. For the purpose of this presentation, only part of the results for station ALGO have been presented as in Figure 1 and tabulated in Table 1. Figure 1 below, represents the plots of the LSSA spectrum using the natural logarithms of the percentage variance versus frequency in cycles per year. Top two plots are for horizontal position, two middle plots are for the horizontal residual and bottom two plots are the product spectrum of the C21, S21 coefficients and residuals; the red dotted line is the 99% confidence level. Spectra of Atmospheric Pressure Loading (APL) and pole tides are not shown for lack of space.

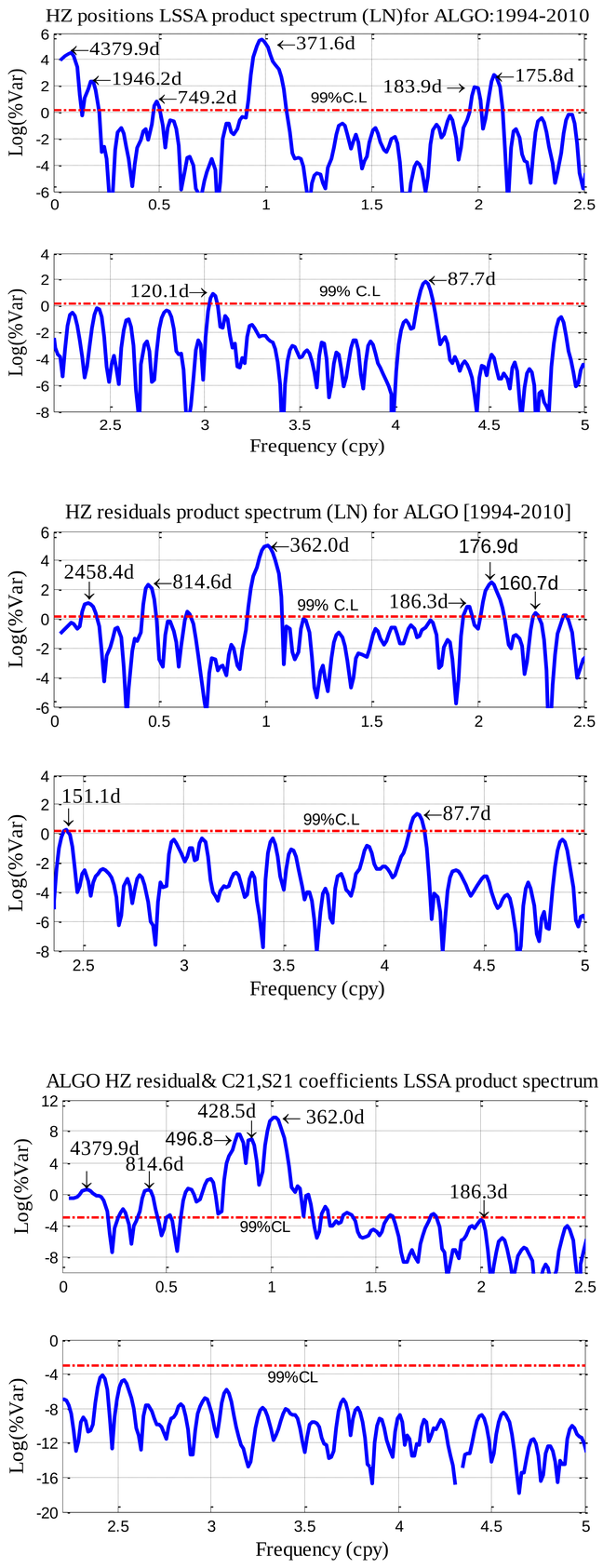

Table1 Impact of error series on HZ residuals

Spectrum	Period (days)	Fidelity (±days)	Amplitude (m)	Phase (Deg)
Positions	371.63	12.0	0.0100	260.80
	183.86	02.9	0.0016	326.26
	175.78	02.7	0.0063	120.60
Residuals	362.02	11.0	0.4391	326.65
	186.30	03.0	0.1236	131.85
	176.89	02.6	0.4502	346.64
Residuals ⊗ CS21	362.02	16.0	2.3957	027.35
	187.60	06.2	0.2652	349.44
Residuals ⊗ APL	362.00	11.4	2.3387	027.89
	176.90	02.7	0.4967	133.65
Residuals ⊗ Pole tides	362.02	12.0	2.2595	319.61

NB: ⊗ represents the frequency domain multiplication

4. Discussions

Results have revealed the existence of insidious periodic signals in the Least Squares Spectrum of both the REPRO1 solutions and residuals. Based on the findings, time series of different candidate error sources were generated using the latest IERS error models [Petit and Luzum, 2010]. We then analyzed using the LSSA frequency domain multiplication of the spectra from the residual and the error series.

Table 1 summarizes the main common peaks identified so far in different LS self-coherency spectrum; along with their amplitudes, phase and fidelity. Fidelity defines the upper and lower limits around a specific significant peak. They indicate a commonality among annual and semi-annual peaks; so far, their magnitude is yet to be established in the present solutions. There also exists unaccounted for peaks in the residual and the horizontal position spectrum. As part of future work, we intend to extend our research to ocean pole tides, temperature, constellation geometry as well as quantify the different error magnitude in our observations

5. Acknowledgements

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