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Description of the HiCum method dedicated to periodical signals analysis

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We introduce the stacking method named HiCum (**Hi**stograms **Cum**ulation). It is an alternative method to analyse signal signatures based on Fourier analysis. Whereas Spectrum Analysis is necessary when the frequency, ωs is not known, in situations where the time period is clearly defined, then the HiCum method is more accurate and is capable of extracting information that would be lost during Spectrum Analysis. It is therefore a powerful tool in monitoring very weak complex interactions by averaging conclusions of long series treatment.

Fourier's Theorem states that any periodic function can be expressed as a sum of sine waves: Z= Σga cos rx + b sin rx) + $^1/_2$c (1)

where r takes integral values and a, b, c are constants.

It can be used as a method of determining the harmonic components of a complex periodic function. Since equation (1) is unchanged by replacing x by x + 2kπ, where k is an integer, it necessarily represents a periodic function in x of period 2π. Consequently in discussing series of this type it is sufficient to consider any 2π or 360° interval. This is basically the principle of stacking. For non constant data density in all the time intervals, we take care to normalize histograms. It allows to apply HiCum to seismic catalogue or to incomplete records.

HiCum software gives a normalized histogram of series of data on a selected periodicity. Doodson argument familiar to tidalists or a priori period are introduced in the

process.

If we adjust cosine functions with fundamental and harmonics periodicities to the HiCum histogram, it becomes easier to evaluate interactions between different components registered by the monitoring devices, by comparison of the different amplitudes and phases.

For each parameter, we obtain a standardized histogram. This pattern allows to inter-compare non equivalent set of data (various sampling rate, erratic events, theoretical models...). Particularly, we obtain the transfer function between two variables with a X-Y graph showing the relationship between the two histograms of variables considered like two parametrical functions. This is very effective to define characteristics of interactions.

We assume that the balance of energies for geophysical experiments in highly heterogeneous media requires a large rejection of spurious mechanisms. Nature of interactions related to astronomical clocking origins, allows to inter-compare on a perfectly synchronized reference, data on very long time intervals. Knowing in advance periodicities from celestial mechanics, it becomes possible to apply a technique of averaging through complete data bank like Hicum stacking method.

The main energy transfers are for the lunar origin, gravitational and for the solar one, gravitational and climatic.

Transformation of types of energies in other types depends of the basic law of physics. Non-linear or dissipative process increase complexity of models. Simultaneously, inductions could modify the output signals and the transfer function of the system. By monitoring for energies transfer processes, time delay and range of application, it could help to detect modification of the medium patterns. Applicability to the forecasting of non linear processes of rupture (earthquakes, volcanic events, land slides, ...), seems to be improved by the way to compare non active time interval results to new results for eventual detection of any significant evolution to rely to risk development. The poster will introduce materials needed to apply HiCum to any kind of long enough data bank. New developments projected are described.

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