

PULSE_XP User's Guide
Chapter 10
Periodic

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Periodic Signal Averaging Methods

Figure 1 illustrates an alternate approach to the analysis of the luteinizing hormone example shown previously that does not require fitting the data to the sum of sine and/or cosine waves. This approach assumes that the physiological signal occurs at a regular interval without assuming that the waveform is a sine or cosine wave. Consider the case depicted in Figure 1 where the assumed period is 460 minutes which (at one data point sampled every 10 minutes) corresponds to 46 data points.

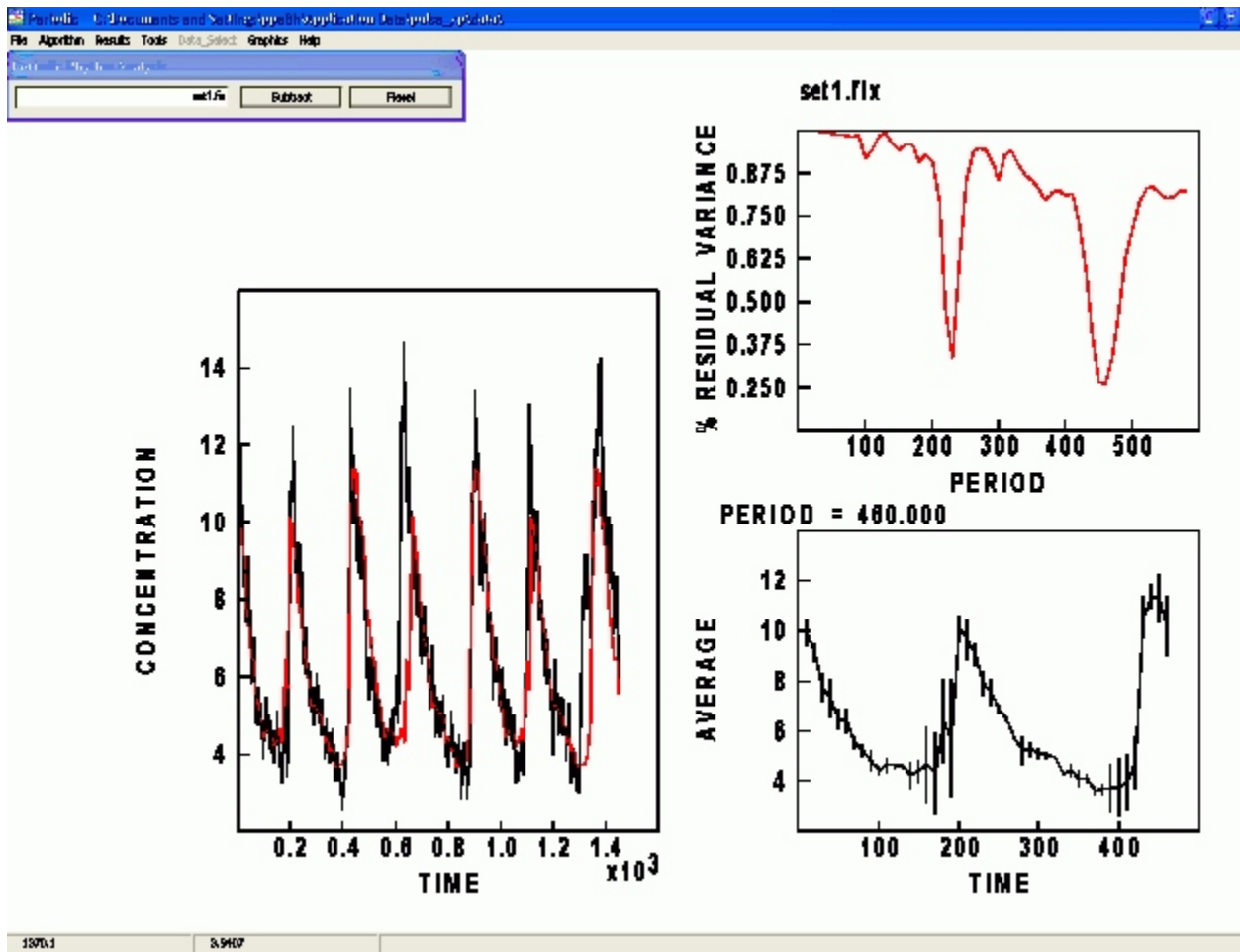


Figure 1

The upper right panel represents the percent of the variance remaining after an arbitrary waveform is subtracted from the data as a function of the period of the waveform. In this case, the period that describes the most variance within the data is 460 minutes. The lower right panel presents a signal-averaged waveform that assumes a period of 46 data points. The first (from the left) point in the lower right panel is the average of the 1st data point, the 47th data point, the 93rd data point, and the 139th data point. The second point in the lower right panel is the average of the 2nd, 48th, 94th, and 140th data points. The third is the average of the 3rd, 49th, 95th, and 141st data points, and so on. The

repeated waveform as shown in the lower right panel of Figure 1 is clearly not a single sine or cosine wave. This process is repeated for a series of different assumed periods from 3 data points to $N/3$ data points where N is the total number of data points.

The upper right panel is the percent of the variance remaining after the waveform of period L is removed from the data plotted as a function of L . In this case the dominant periodicities occur at periods of 230 and 460 minutes. The 460 minute waveform is essentially two cycles of the 230 minute waveform with slightly different amplitudes. In this example, the 230 minute waveform accommodates 63.7% of the variance and the 460 minute periodic waveform describes 72% of the variance. The left panel in Figure 1 is the luteinizing hormone data shown in previous chapters of this documentation and the 460 minute periodic waveform shown in the lower right panel of Figure 1 (i.e. the dashed line). This approach is not without problems. Note that the alignment of the peaks of the data and the peaks of the periodic waveform is not exact. This method assumes that the secretion events (i.e. the peaks) are equally spaced when in reality they may not be.

The objectives for the analysis of the hormone time-series data include the characterization of the number, times, masses, and shapes of the pulsatile secretory events that increase the hormone concentration in the blood. The amount of basal (non-pulsatile) secretion is also of interest as is the description of the time course of the pharmacokinetics elimination (removal from the blood) of the hormones. Thus, it should be noted that the Fourier and signal averaging methods presented in this chapter do not estimate these characteristics.

Execution of Periodic

Open a data file by clicking on **File**→**Read a Data File**→**??? mode** (for this demonstration a *.fix file has been selected). The hormone concentration profile will appear on the lower left panel of the screen under a command panel which contains the data file name along with a **Subtract** and **Reset** command. The upper right hand side of the screen provides a graphic representation of the percentage of the residual variance for a given period.

Figure 2 again utilizes the file Set1.fix. The crosshairs have been positioned directly on the period shown to have the greatest percentage of residual variance at 460 min. In order to ascertain whether or not this is a good description of the data, the user should click on this point and the graph will now appear as the one in Figure 1. Notice now that in the concentration plot in the lower left hand graph, there is now a continuous red line which depicts a fit assuming a period of 46 data points (or 460 min). The lower right panel shows the signal-averaged waveform given this assumption.

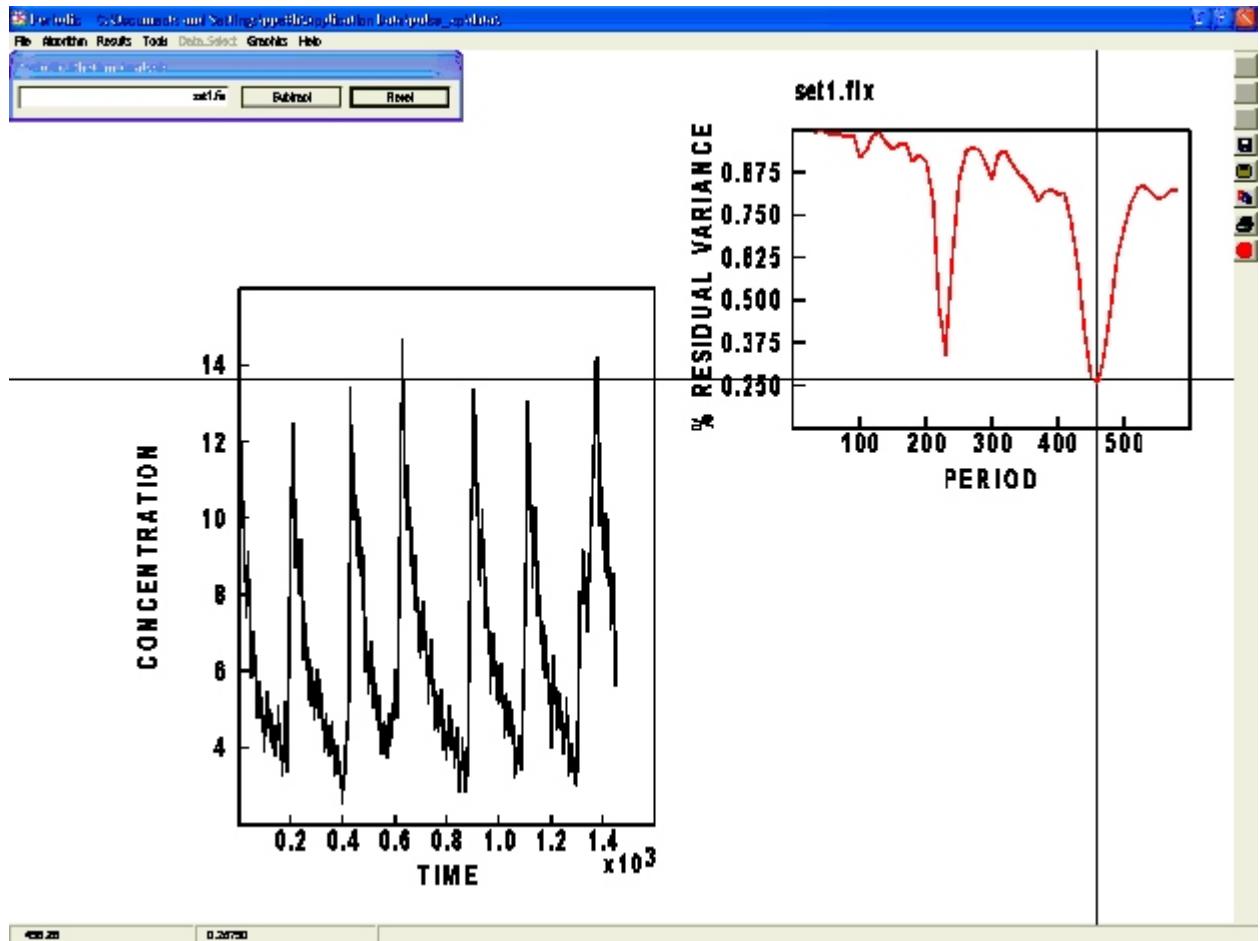


Figure 2