Signal processing via Mathematical Model using Fourier Transforms and Least Square Optimization function.

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ABSTRACT

Signal processing is concerned with finding the underlying trend of stock prices by identifying the de-trended signal and subtracting it from the main signal (the original stock price fluctuations).

Signals in the real world often have a periodic nature and, in this paper, we will try to extract and visualize the cyclical component of the de-trended signal. We will try to achieve that using Fourier transforms. The Fourier transform is a transformation from the time domain into the frequency domain; that is, the linear decomposition of a periodic signal into sine and cosine functions with various frequencies.

We will then improve the filter by omitting the noise to leave us with only the main frequency component. We will achieve this by using an optimization algorithm. Several optimization algorithms are provided by the *scipy.optimize* module. One of the algorithms is the least squares fitting function: *leastsq*. When calling this function, we are required to provide the residuals (error terms) function. This function is used to minimize the sum of the squares of the residuals. It corresponds to our mathematical model for the solution. Also, it is necessary to give the algorithm a starting point. This should be a best guess—as close as possible to the real solution. Otherwise, execution will stop after about 800 iterations. Finally, we will try and fit a sinusoidal pattern to the de-trended data and plot our results.

Keywords: Signal processing, Fourier transforms, Optimization, Amplitude, Frequency, Phase, and Vertical offset.