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APPLICATION OF WAVELET TRANSFORM ON SIGNAL ANALYSIS

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Like the Fourier Transform, Wavelet Transform decomposes signals into simple units and the original signals can be reconstructed from them. Fourier Transform decomposes signals into sine and cosine functions of different frequencies, while Wavelet Transform decomposes signals into wavelets.

Since Fourier Transform is a global integration transform and there is no time factor in it, it cannot analyze nonstationary signals whose statistical properties change with time. In order to analyze nonstationary signals, we need decompose signals into units which are localized in both time and frequency domain. Basic theory of Fourier Transform tells us that there is trade-off between time and frequency compactness. This problem is solved by decomposing the signal several times at different levels. This is the essence of multiresolution analysis method developed by Stephane G. Mallat. Mallat summarized some fundamental theorems of multiresolution analysis, which state the existence of scaling functions and wavelets, and proposed a procedure to decompose and reconstruct signals when given a certain wavelet. Ingrid Daubechies at Bell Laboratories found out how to construct a suitable wavelet. A team in Texas A & M university indicated that a special wavelet constructed by B-spline function had certain properties that are useful in signal analysis.

According to the results of the above sources, we have the mathematical formulas and a procedure for signal analysis using a second-order B-wavelet.

I write a program package in Mathematica to implement the decomposition and reconstruction algorithms. I use the program facilities in Mathematica and apply the object-oriented programming concept so that the package can be used just as a build-in package. The programs are developed by first running on-line commands step by step to make sure they are correct. Then these commands are collected in a package. Finally the package is put in the right place of the directory and an appropriate path name is assigned to Mathematica so that it can find it automatically. Several pictures of scaling functions and wavelets are plotted using Mathematica. Some artificial signals are experimented. Future work will be the analysis of some real signals and find a better way to deal with boundary points.

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