A Novel Filter for Tracking Trends in Noisy Real-Time Data

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Noise in data can mask underlying trends. These trends can consist of ramps, steps, spikes, sinusoids, etc., and may provide important information about the process being monitored. In order to observe these trends, the data can be filtered to reduce the noise. However, filtering tends to remove useful information as well; it rounds corners, introduces phase lag (delay), and fails to fully capture legitimate rapid changes such as spikes in the data. This work presents a novel computer algorithm that can smooth noisy data to expose the underlying trend, but can react quickly to fully capture sudden changes in the trend. The algorithm is based on an exponential smoothing filter with a modification that enables the coefficients to change when the measurement is sufficiently far from the previous smoothed value. This serves two purposes. First, it provides excellent tracking of large rapid changes in the signal. Second, for certain applications where the time of the rapid change in the signal is important, the coefficient itself can be used as an indicator of this change. Three simple tuning parameters make the filter very flexible and the adjustment intuitive. The algorithm was tested on a variety of noisy datasets containing steps and spikes. It worked very well, and in particular, when there were features of the data that needed to be extracted (e.g., P and S wave leading edges in seismic data, and QRS complex in ECG data), the filter coefficient was very effective detector.

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