Adaptive Mathematical Framework for Real-Time Noise Reduction in Dynamic Time Series Data for ADITYA-U

Abstract

A comprehensive mathematical framework needs to be developed for smoothing trends in time series numerical data with the primary objective of eliminating unwanted noise from real-time measurements. We are scanning various diagnostic data to feed into the model for predicting future values based on input sequences from different diagnostics at ADITYA-U. Our approach begins with a formal characterization of noise patterns in temporal data, distinguishing between random fluctuations, systematic distortions, and outliers. We then develop an adaptive methodology that selects optimal smoothing parameters based on the underlying statistical properties of the time series, including autocorrelation structures, frequency components, and change point distributions. A key contribution is our introduction of a hybrid algorithm that combines local polynomial regression with statistical threshold controls, enabling robust trend extraction while preserving critical signal features and transient phenomena.

We explore various mathematical techniques including e.g. moving averages, exponential smoothing, Savitzky-Golay filtering, wavelet transforms, and Kalman filtering to address the pervasive challenge of signal-to-noise ratio optimization in dynamic data streams. This work provides both theoretical foundations and practical implementing mathematical smoothing techniques that effectively separate meaningful trends from noise in continuously streaming data.

Academic Project Requirements:

1) Required No. of student(s) for academic project: 2

2) Name of course with branch/discipline: B.E./B.Tech. Computer Engineering/IT/MCA

3) Academic Project duration:

(a) Total academic project duration: 8 Weeks
(b) Student's presence at IPR for academic project work: 5 Full working Days per week

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