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## Abstract

This article proposes a multistage framework for time series analysis of user activity on touch sensitive surfaces in noisy environments. Here multiple methods are put together in multi stage framework; including moving average, moving median, linear regression, kernel density estimation, partial differential equations and Kalman filter. The proposed three stage filter consisting of partial differential equation based denoising, Kalman filter and moving average method provides ~25% better noise reduction than other methods according to Mean Squared Error (MSE) criterion in highly noise susceptible environments. Apart from synthetic data, we also obtained real world data like hand writing, finger/stylus drags etc. on touch screens in the presence of high noise such as unauthorized charger noise or display noise and validated our algorithms. Furthermore, the proposed algorithm performs qualitatively better than the existing solutions for touch panels of the high end hand held devices available in the consumer electronics market qualitatively.

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## **Index Terms**

Computer Science

Signals And System

**Keywords**

Touch Sensing Time Series Analysis Pervasive Computing Human Computer  
Interaction Sensor  
Signal Processing  
Adaptive Filtering  
Ambient Intelligence