Project Synopsis

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Topic : Dynamic Forecasting with Kalman Filters
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Abstract:
In the evolving landscape of Data Science, the utilization of advanced algorithms becomes imperative for accurate predictions and dynamic system monitoring. This project delves into the transformative potential of Kalman Filters, originally crafted for control theory, and explores their robust application in the realm of Data Science. Kalman Filters provide a sophisticated framework for state estimation amidst the complexities of noisy data and inherent uncertainties. By adapting this mathematical algorithm, traditionally employed in predicting the trajectory of missiles and satellites, the project endeavors to showcase its adaptability in dynamic forecasting within time-series analysis and sensor data fusion. This intersection of established control theory with contemporary Data Science practices offers a promising avenue for enhancing predictive accuracy and resilience in the face of real-world uncertainties.

Objectives:

- To implement a Kalman Filter for time-series forecasting in a simulated or real-world dataset.
- To assess the predictive accuracy of the Kalman Filter compared to traditional forecasting methods.

Methodology:

1. Dataset Selection

Choose a suitable time-series dataset or simulate one that exhibits dynamic behavior.

2. Kalman Filter Implementation:

Let's consider a simple scenario where we have a one-dimensional dataset representing the position of an object over time. We'll simulate noisy measurements of this position and use a Kalman Filter to estimate the true position in python.
Code & Result link :
https://github.com/shashwatismicro/DynamicForecasting_KalmanFilter/blob/main/basicKalmanFilter.ipynb

3. Evaluation Metrics:

Define metrics to evaluate the performance of the Kalman Filter, such as Mean Absolute Error (MAE) or Root Mean Squared Error (RMSE).

4. Comparison with Traditional Methods:

Compare the forecasting accuracy of the Kalman Filter with traditional time-series forecasting methods.

Expected Outcomes:

- A robust Kalman Filter implementation for dynamic time-series forecasting.
- Comparative analysis highlighting the strengths and weaknesses of the Kalman Filter in Data Science applications.

Significance of the Project:

This project contributes to the understanding of how Kalman Filters, originally designed for control systems, can be adapted for predictive analytics in the field of Data Science. The findings have implications for improving forecasting accuracy and handling noisy sensor data in dynamic systems.

Conclusion:

The project seeks to bridge the gap between traditional control theory and modern data science applications, demonstrating the versatility of Kalman Filters in forecasting dynamic systems.