Esp32 Filter data sensor

Filter data sensor

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Goal

- Memahami Sensor Filter
- Mendesain dan implementasi Moving Average Filter
- Membuat API python

01

Filter

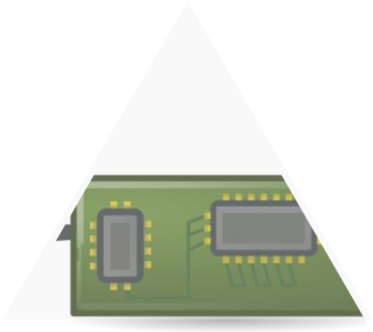
Pengenalan

Filter works

Many modern systems utilize multiple sensors to estimate hidden (unknown) states through a series of measurements.

What is a filter anyway? In practical terms, the filter should **smooth out erratic sensor** data with as little time lag, or ‘error lag’ as possible. The simplest filter, that many of us will have already used, is to pause our code, take about 10 quick readings from our sensor and then calculate the mean by dividing by 10. Incredibly simple and effective as long as our machine or process is not **time sensitive** – perfect for a weather station temperature sensor, although wind direction is slightly more complicated. A wind vane is actually an example of a good sensor giving ‘noisy’ readings: not that the sensor itself is noisy, but that wind is inherently gusty and is constantly changing direction.

Filter for esp32

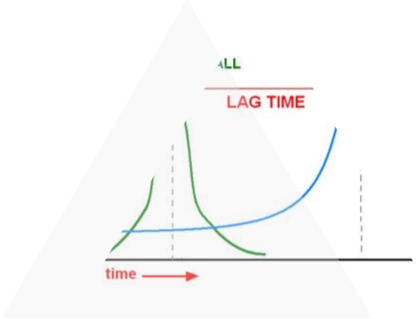


Float data

Input from sensor

Memory

Don't clog memory



Delay

Lag time from input to response

Filter esp32

Filter Sensor

Variance dan standar deviation

The Variance is a measure of the spreading of the data set from its mean. The Standard Deviation is the square root of the variance.

The standard deviation is denoted by the Greek letter σ

(sigma). Accordingly, the variance is denoted by σ2.

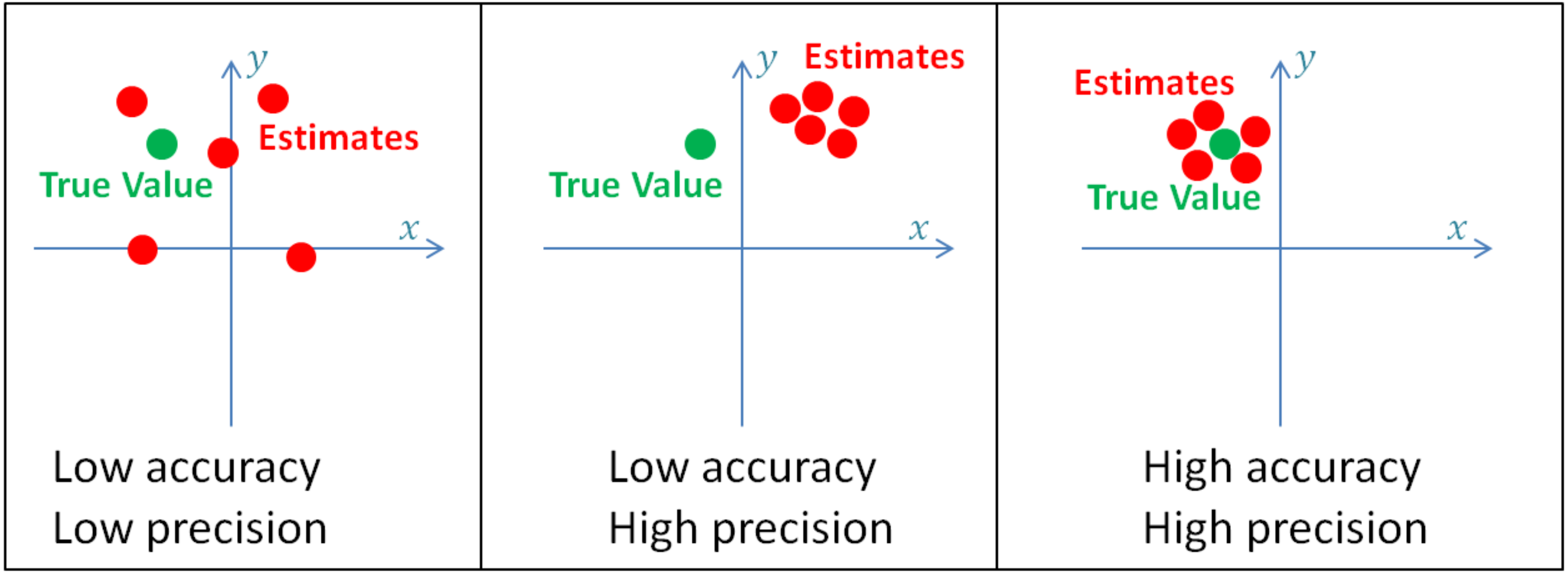
$$\sigma^2 = \frac{1}{N}\sum_{n=1}^{N}(x_n - \mu)^2$$

Random variable

A random variable describes the hidden state of the system. A random variable is a set of possible values from a random experiment.

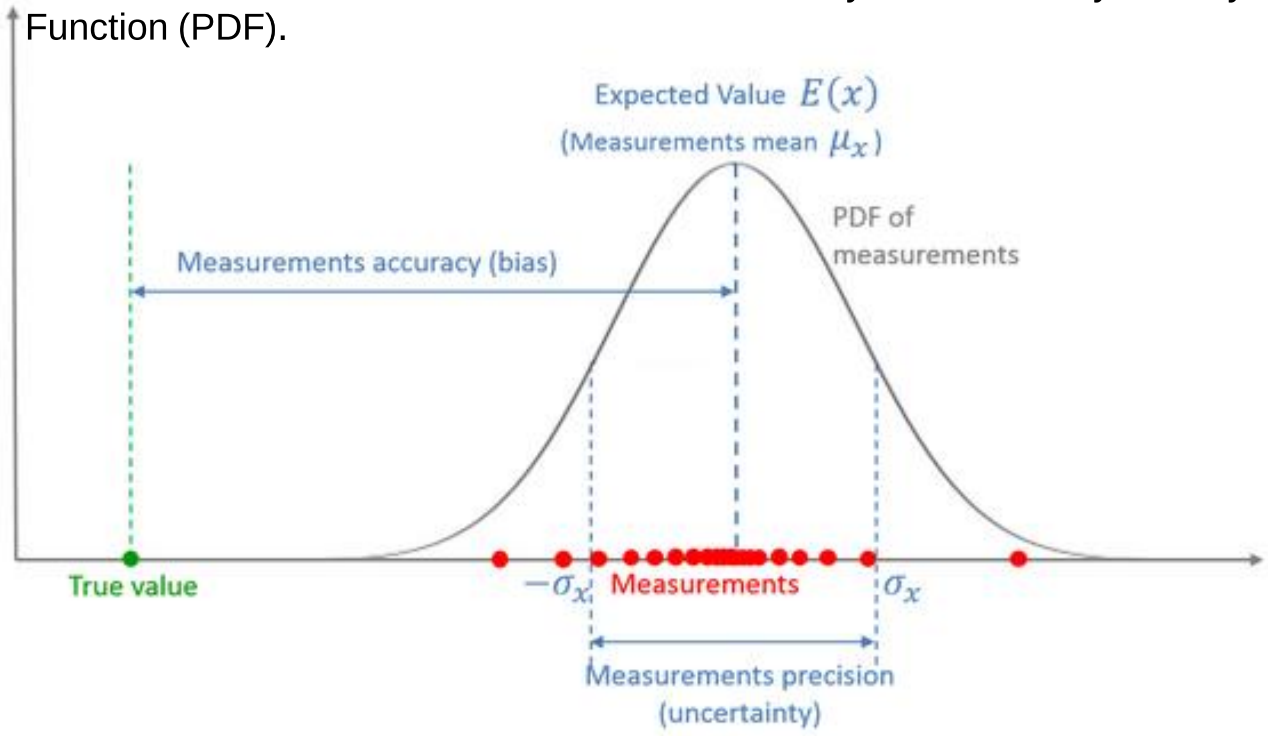
Accuracy vs Precision

Accuracy indicates how close the measurement is to the true value. Precision describes the variability in a series of measurements of the same parameter. Accuracy and precision form the basis of the estimate.



PDF

A measurement is a random variable, described by the Probability Density Function (PDF).



Error in filter sensor

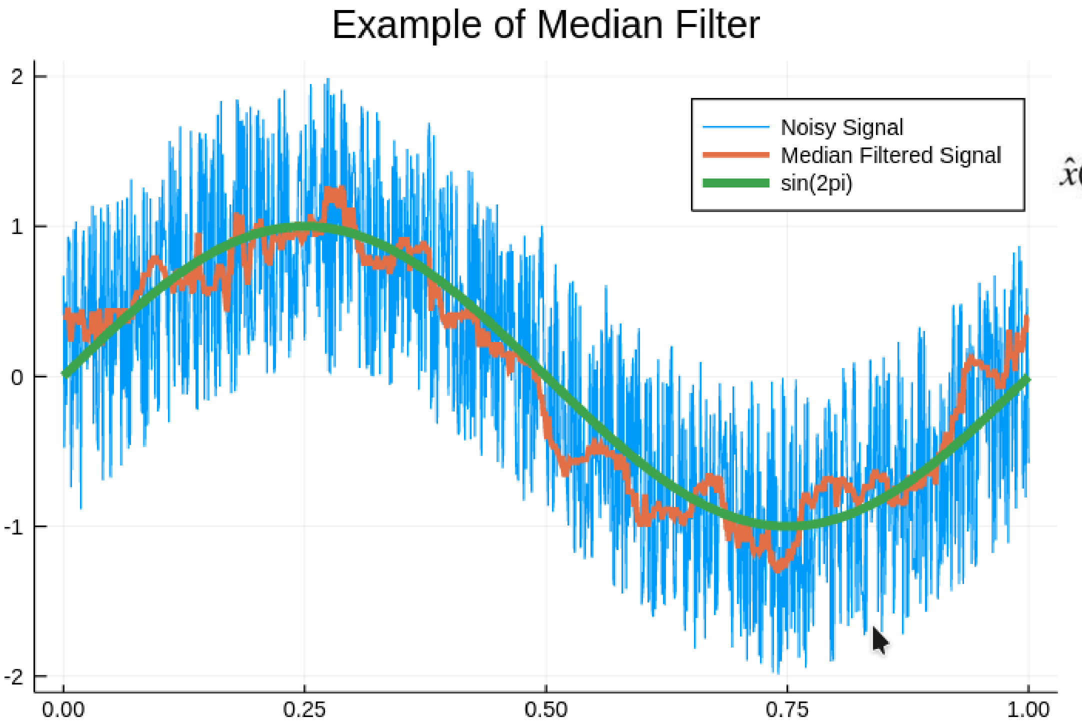
- Dynamic error
- Systematic error
- Bias error
- Truncation error

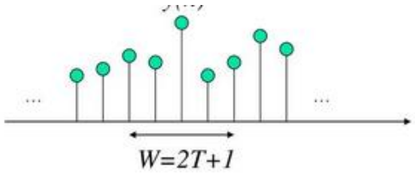
Simple Moving Average

'Simple Moving Average' (SMA), the 5 latest readings are updated with 1 fresh reading

$$W = \frac{1}{N}\sum_{n=1}^{N} W_n = \frac{1}{5}(79.8 + 80 + 80.1 + 79.8 + 80.2) = 79.98kg$$

Median FIlter



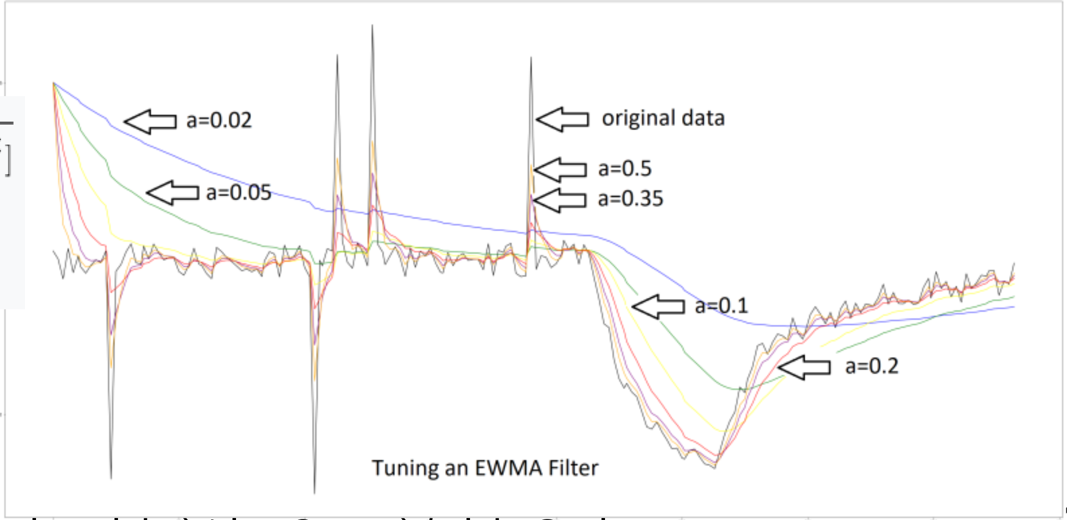


$$\hat{x}(n) = median[\,y(n-T),\ldots,\,y(n),\ldots,\,y(n+T)]$$

EWMA

Exponentially Weighted Moving Average' (EWMA)

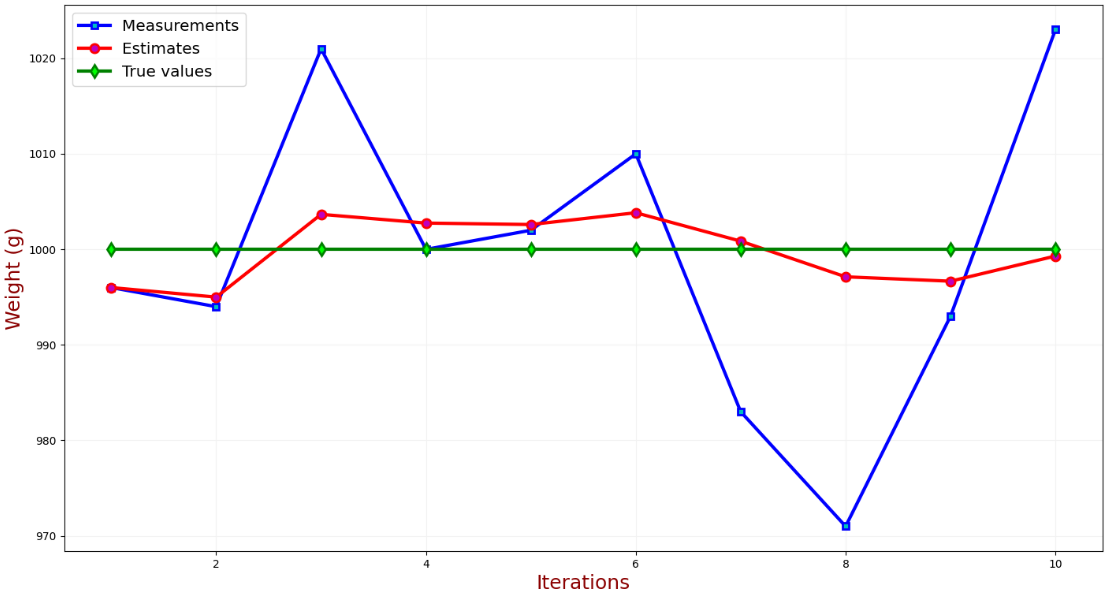
Control limits	$T \pm L \frac{S}{\sqrt{n}} \sqrt{\frac{\lambda}{2-\lambda}\left[1-(1-\lambda)^{2i}\right]}$
Plotted statistic	$z_i = \lambda \bar{x}_i + (1-\lambda)\, z_{i-1}$



output = (alpha * reading + (alphaScale - alpha) * lastOutput) / alphaScale

Kalman FIlter

The estimate of the current state = Predicted value of the current state + Factor x (Measurement − Predicted value of the current state)



$$\hat{x}_{n,n} = \hat{x}_{n,n-1} + \frac{1}{n}\left(z_n - \hat{x}_{n,n-1}\right)$$

API with python

API pada Server

Application Programming Interface (API)

GET/POST/PUT/PATCH/DELETE

Thanks

Do you have any question?

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