How to resolve these noise

The mainly used technique to minimize these noise is to use:

- Kalman Filtering technique (KF)

Sometime Complementary filters(C.F) are also used

Kalman filtering (KF)

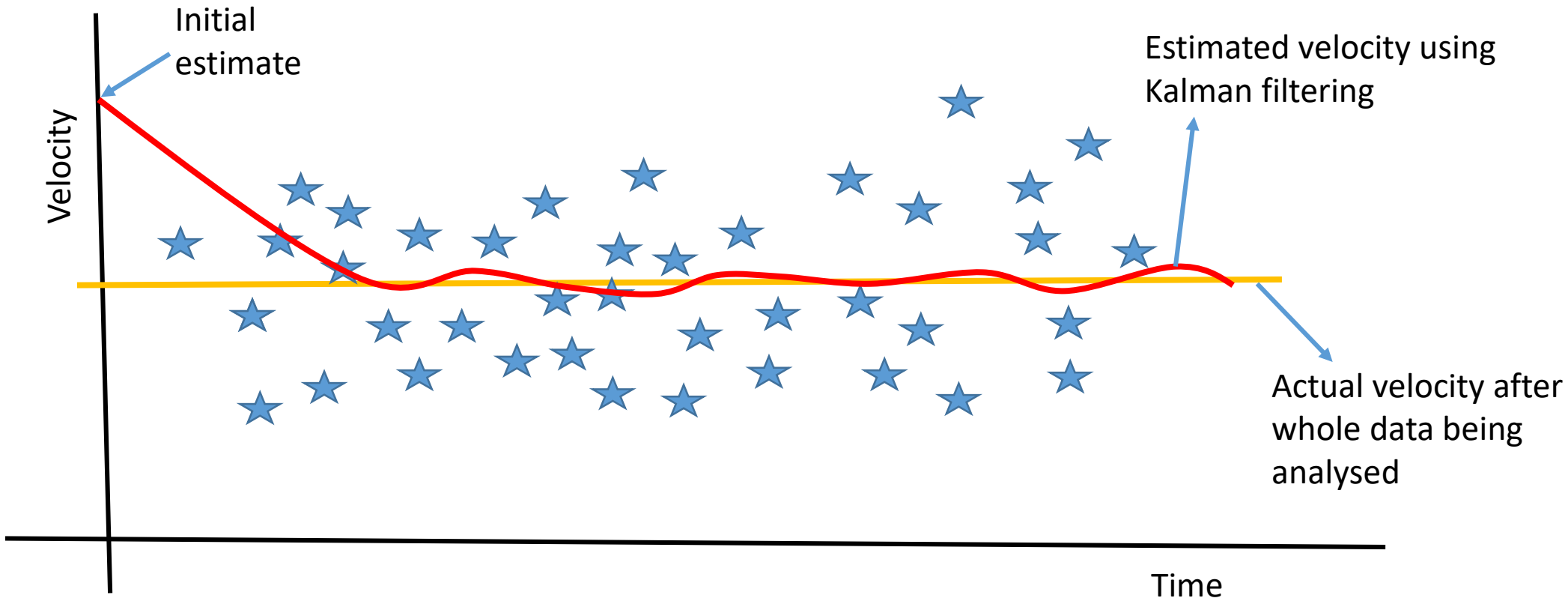
- Is a optimal estimation algorithm
- A kalman filter is a more sophisticated smoothing algorithm
- Minimizing noise from measurement by sensor is the purpose of Kalman filter.

Cont…

- It is an iterative mathematical process that uses a set of equations and consecutive data inputs to quickly estimate the true value(MPV), position, velocity etc. of the object being measured.
- It is an tools to estimate the predicted value

Cont…

- Basic understanding for Kalman filtering



Cont...

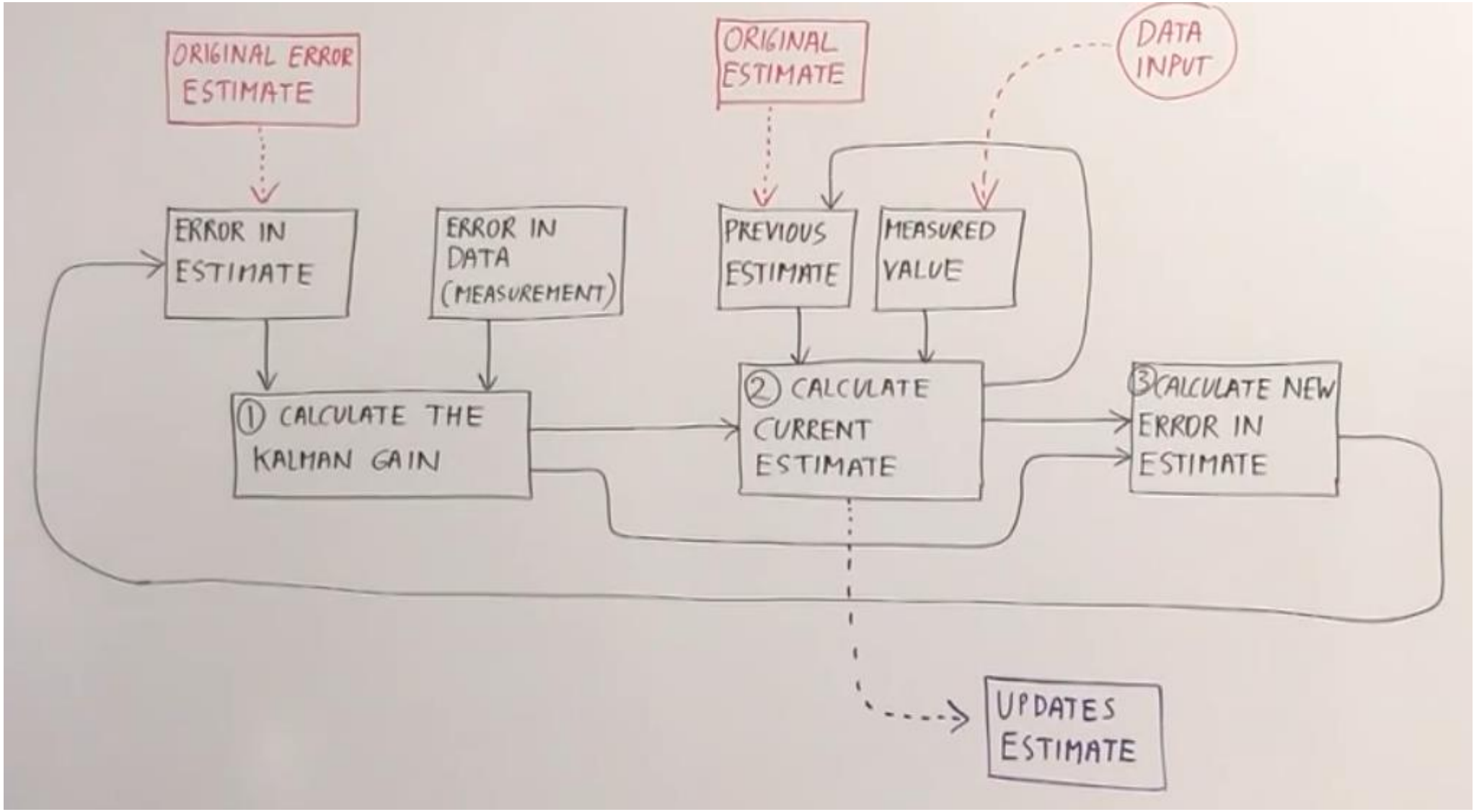


Fig : Kalman Filtering Model

Cont...

- In Conducting Kalman filtering there are 3 main calculation that needs to be done

1st = Calculate the Kalman gain

:::These calculations are iterative so that the estimate narrows down into actual correct value

2nd = Calculate current estimate

::::Each time it update the current estimate

3rd = Finally recalculate the new error in the estimate

So what do we need in order to calculate the Kalman Gain????

Cont…

- We need 2 things

✓ we need to know the error in the estimate (here once we have original error an put into our system we never go back to original error estimate

✓ Second we need error in the measured (input) data

- Both of these are feed into our calculation
- Gain puts a relative importance in

➢ Error in the estimate

➢ Error in the measured data

i. if error in estimate = smaller =K.F puts more importance in measured data

ii. If error in the data = smaller = K.F puts more importance in estimate

Cont…

- Secondly the calculation of current estimate is done
- For this it require Kalman Gain, and also depends on previous estimate, and measured value
- And the gain will decide how much weight to put onto the measured value and pervious estimate
- Finally once we have calculated the current estimate than system calculates the error in the estimate, so it can be used in the next iteration

Kalman Gain

- Actually it is used to determine how much of the new measurement to use to update the new estimate

Let,

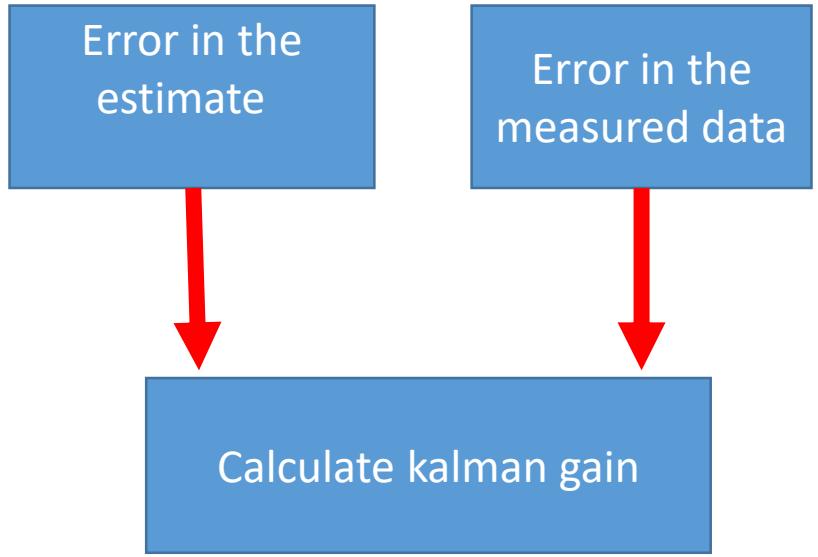
Kalman Gain = KG

Error in the estimate = E_{est}

Error in the measurement = E_{mes}

$$\therefore KG = \frac{Eest}{Eest+Emea}$$

Note ($0 \leq KG \leq 1$)



Cont...

- Now,

  Current Estimate = EST_t

  Previous Estimate = EST_{t-1}

  New measurement = MES

  :: $EST_t = EST_{t-1} + K.G[MEA - EST_{t-1}]$

Remember

If K.G = higher → error in measurement (E_{mea}) → small

i.e our measurement is accurate

✓More relative weightage on E_{est}

IF K.G = Small → error in estimate (E_{est}) → small

i.e our estimate is more accurate

✓ More importance(weight) on measurement