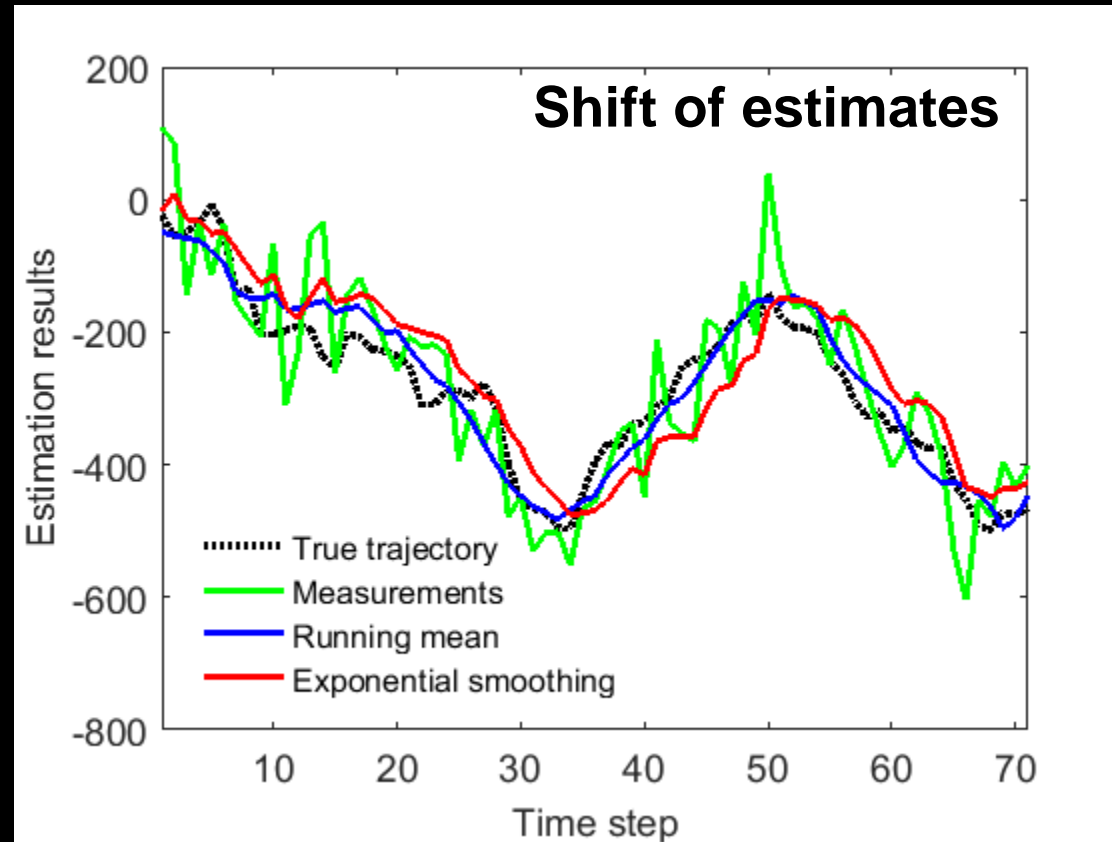


“Experimental Data Processing”

Assignment 2 Discussion

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Term 1, September-October 2020
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Shift of estimates in exponential smoothing

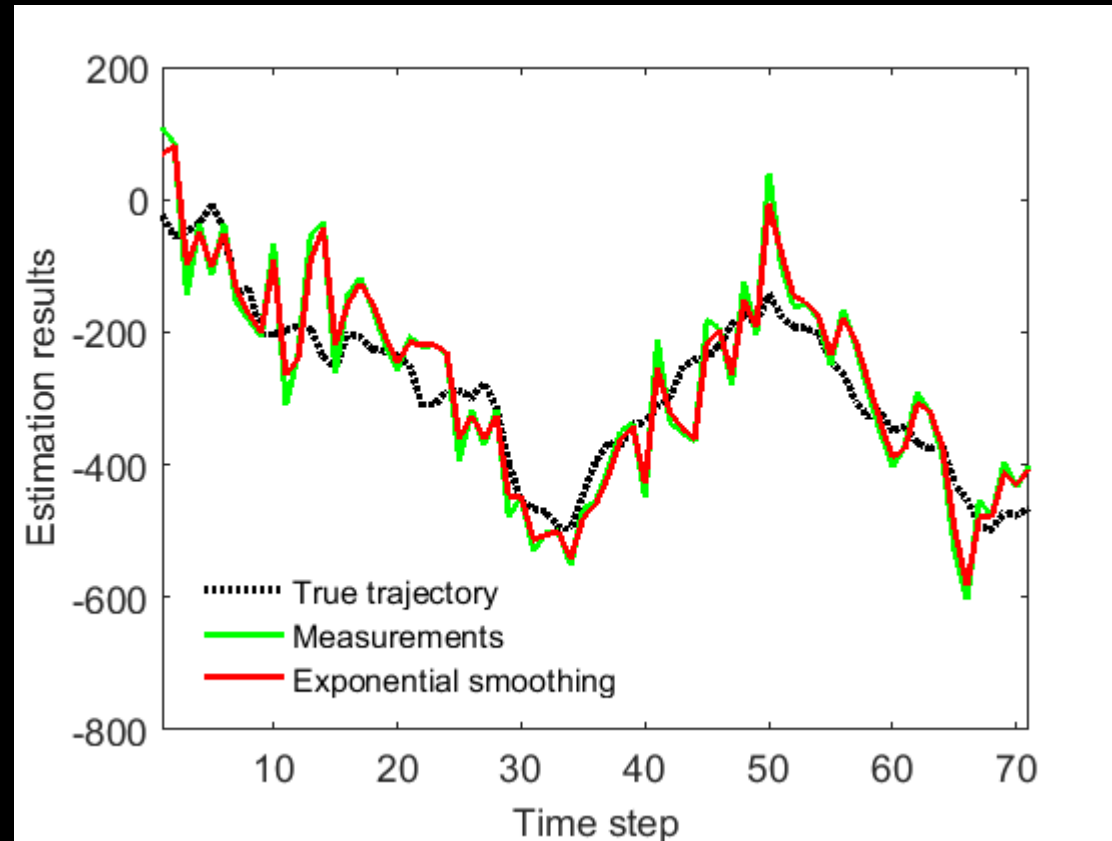


Optimal
smoothing
constant
 $\alpha = 0.25$

Equal component
of estimation error
related with
measurement errors

Size of
running mean
window
 $M = 7$

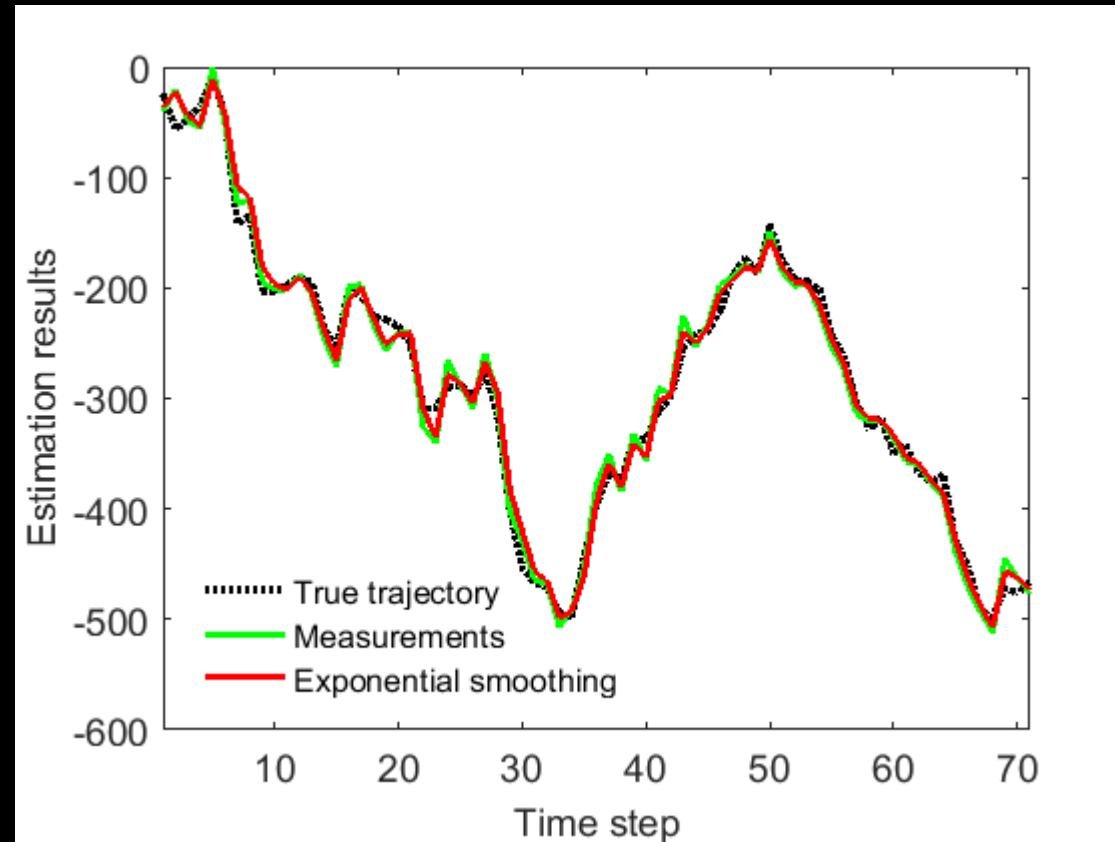
No filtration of measurement errors



**Non-optimal
smoothing
constant**
 $\alpha = 0.8$

**No shift
of estimates,
but no filtration of
measurement errors**

Smoothing in conditions of small measurement errors



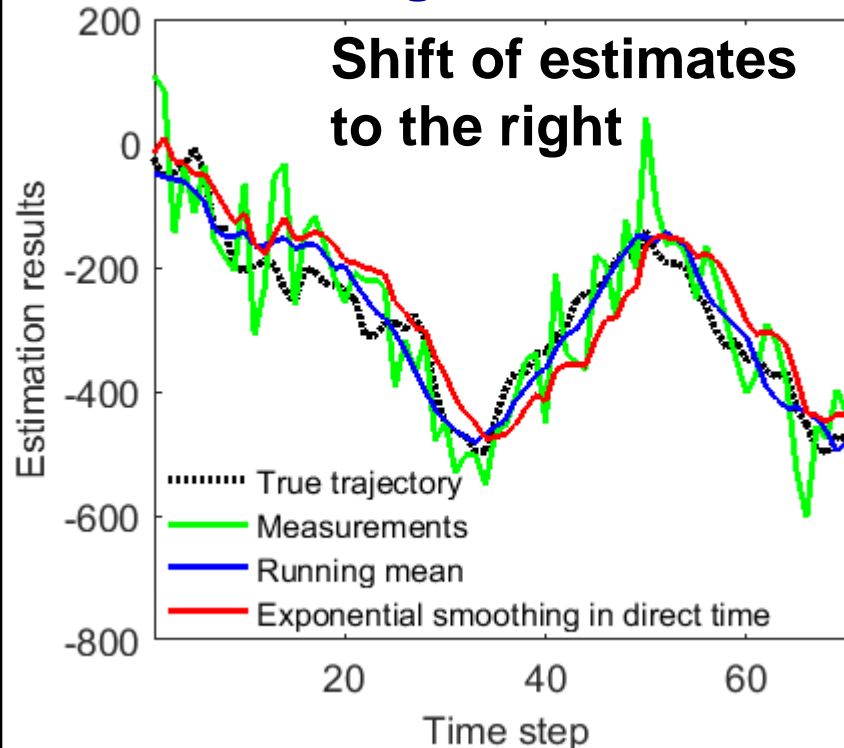
**Optimal
smoothing
constant**
 $\alpha = 0.81$

**Small measurement errors -
small estimation problems**

Shift of estimates in exponential smoothing

→ Smoothing in direct time

← Smoothing in backward time



Shift of estimates
by exponential
smoothing in
backward time?

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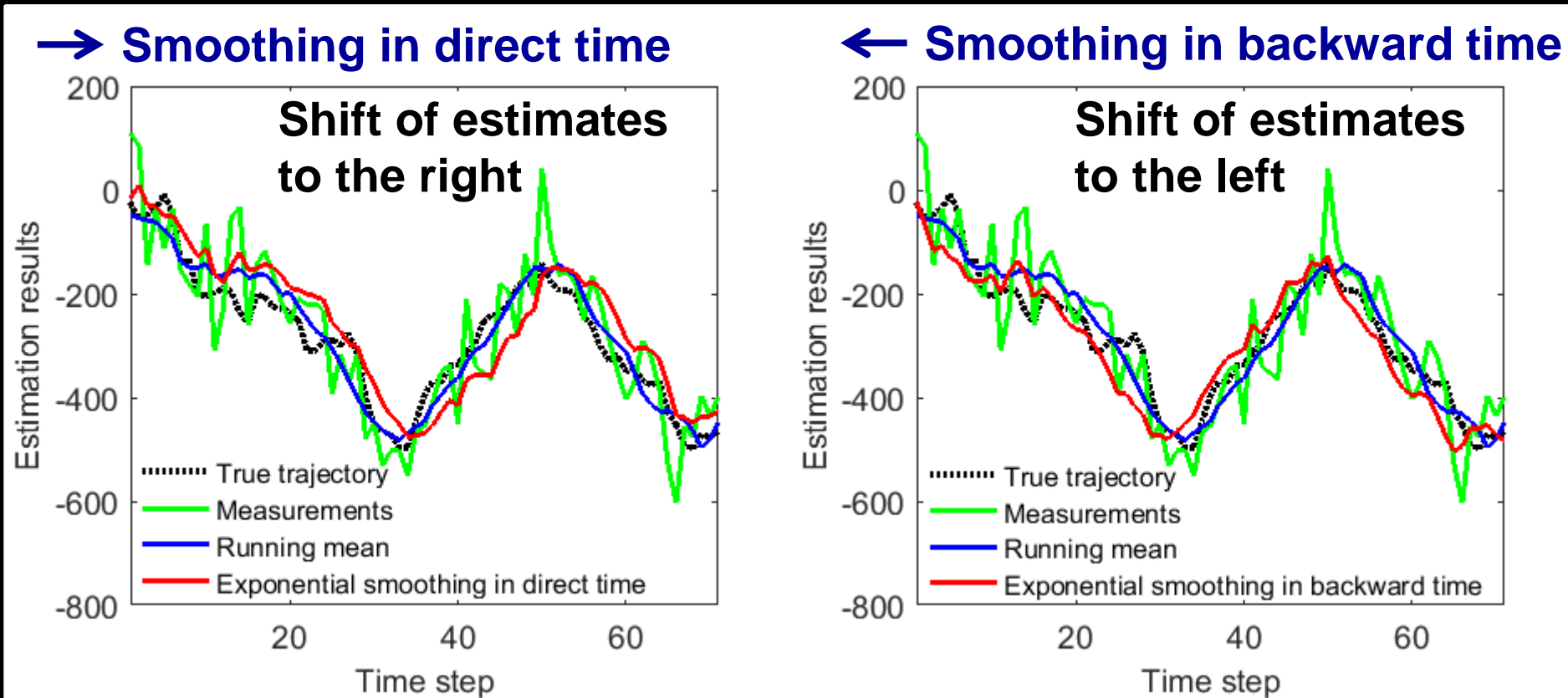
57 81 89 0

Optimal
smoothing
constant
 $\alpha = 0.25$

Equal component
of estimation error
related with
measurement errors

Size of
running mean
window
 $M = 7$

Shift of estimates in exponential smoothing



Optimal
smoothing
constant
 $\alpha = 0.25$

Equal component
of estimation error
related with
measurement errors

Size of
running mean
window
 $M = 7$

Forward – backward exponential smoothing

→ ① Forward exponential smoothing

$$X_i^f = X_{i-1}^f + \alpha (z_i - X_{i-1}^f), i = 2, \dots, N$$



Forward – backward exponential smoothing

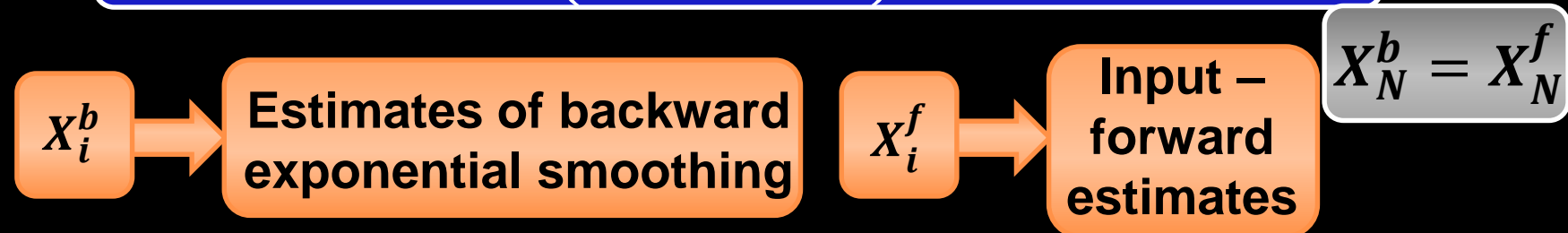
→ ① Forward exponential smoothing

$$X_i^f = X_{i-1}^f + \alpha (z_i - X_{i-1}^f), i = 2, \dots, N$$

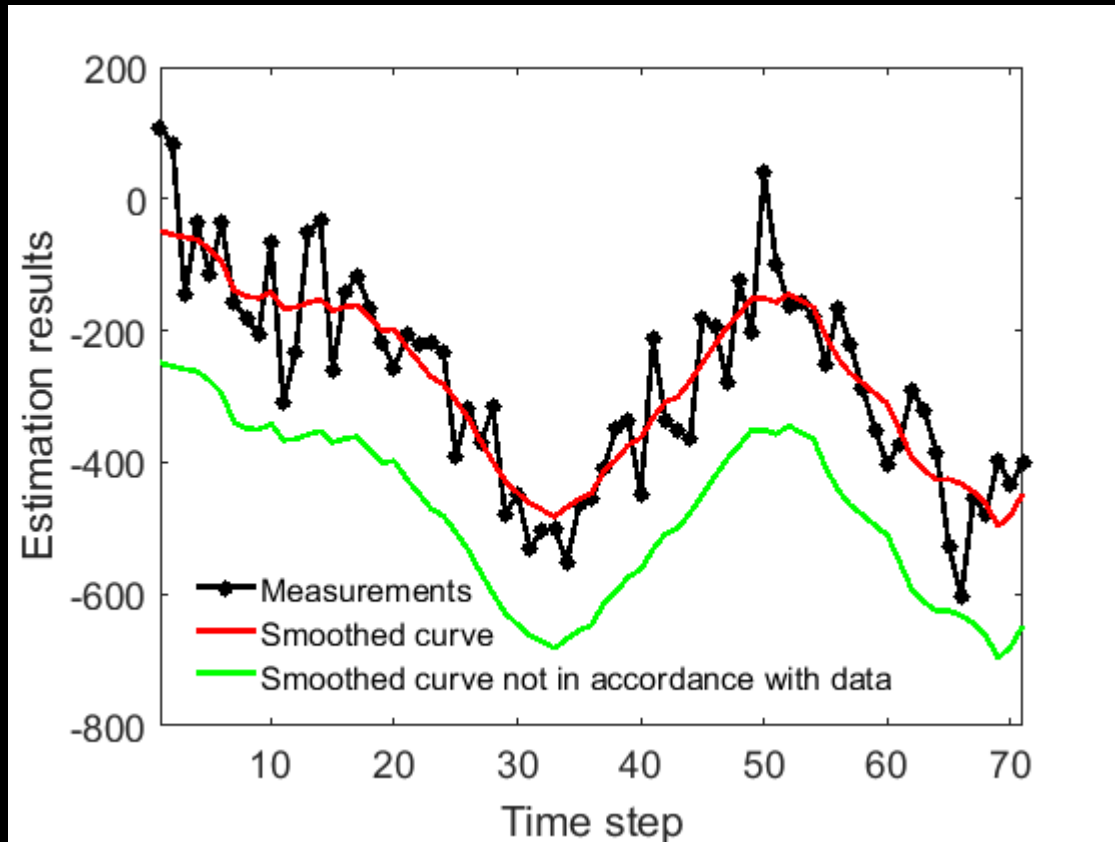


← ② Backward exponential smoothing

$$X_i^b = X_{i+1}^b + \alpha (X_i^f - X_{i+1}^b), i = N - 1, \dots, 1$$



How to verify the effectiveness of smoothing when true trajectory is unknown?



Requirement
of estimation
to be close to
measurements

1

Deviation
indicator



$$I_d = \sum_{i=1}^N (z_i - \hat{X}_i)^2$$

z_i - measurements
 \hat{X}_i - estimation

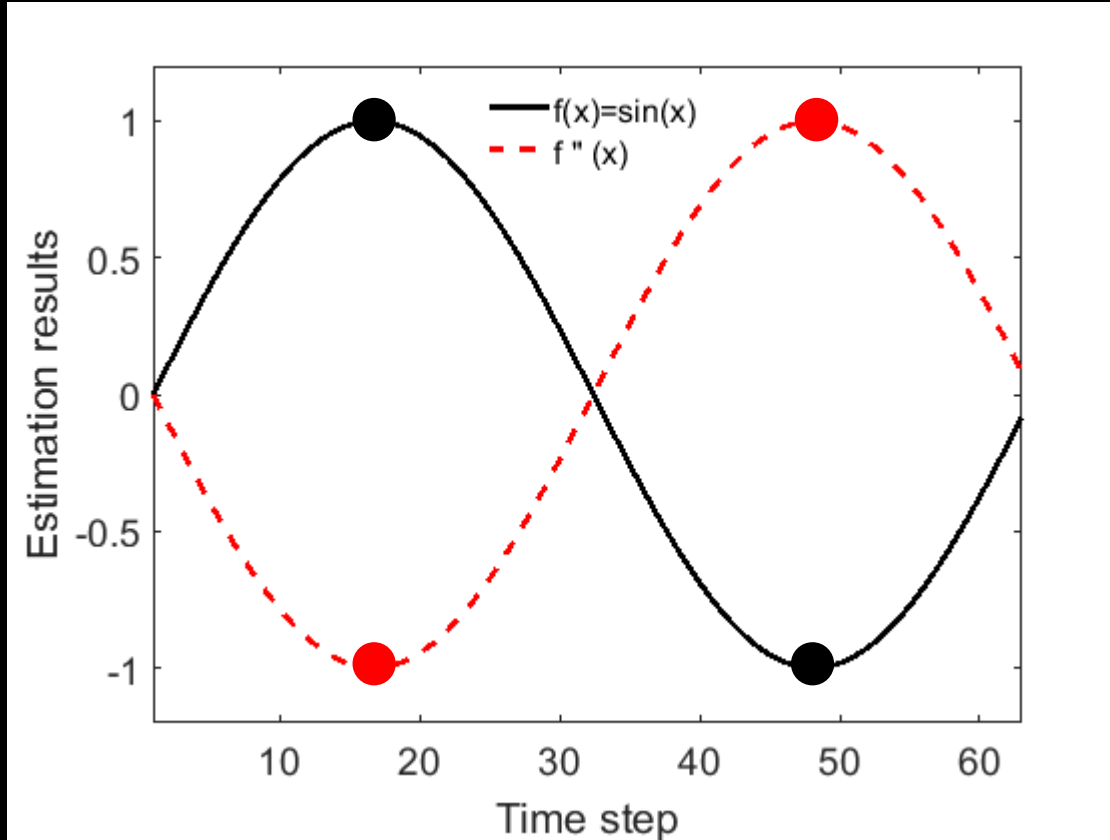
How to verify the effectiveness of smoothing when true trajectory is unknown?

1 Deviation indicator $\Rightarrow I_d = \sum_{i=1}^N (z_i - \hat{X}_i)^2$

$I_d = 0 \Rightarrow$ No filtration of measurement noise
 $\hat{X}_i = z_i$

Not enough to use only deviation indicator.
Additional criterion is needed

How to verify the effectiveness of smoothing when true trajectory is unknown?



Absolute value of second derivative is maximal at points of the greatest “variability” of curve

Maximal rate of change of the process

2 Variability indicator

$$I_v = \sum_{i=1}^{N-2} (\hat{X}_{j+2} - 2\hat{X}_{j+1} + \hat{X}_j)^2$$

\hat{X}_i - estimation