

“Experimental Data Processing”

Assignment 7 Tracking in conditions of correlated state and measurement noise

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**Standard Kalman filter
provides optimal estimate**



**State noise and measurement noise
are uncorrelated and unbiased**

**In practice these assumptions
are often not true**



**Analysis and modifications
of Kalman filter**

Correlated state noise

In practice correlated noise is often presented as a Gauss-Markov first-order process

Random acceleration

$$a_i = e^{-\lambda T} a_{i-1} + \zeta_i$$

ζ_i

Uncorrelated noise with variance

$$\sigma_{\zeta}^2 = \sigma_a^2 (1 - e^{-2\lambda T})$$

λ

Value that is inverse to correlation interval

$$\lambda = 1000$$

a_i - uncorrelated noise

$$\lambda = 0.1$$

a_i - correlated noise

T

Time interval between measurements

σ_a^2

Variance of acceleration

Moving object which trajectory is disturbed by correlated random acceleration

Motion
model



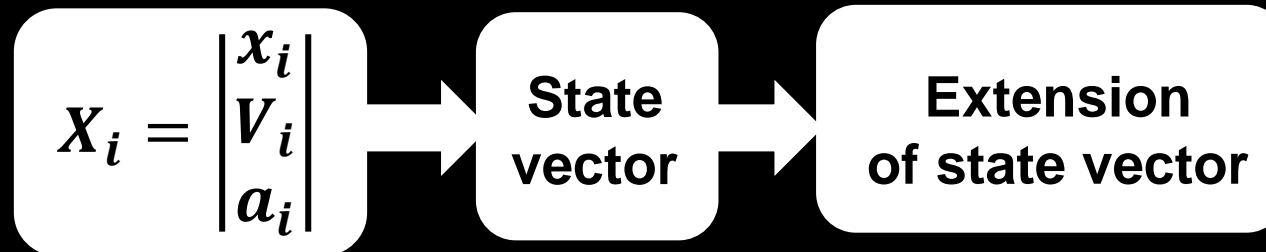
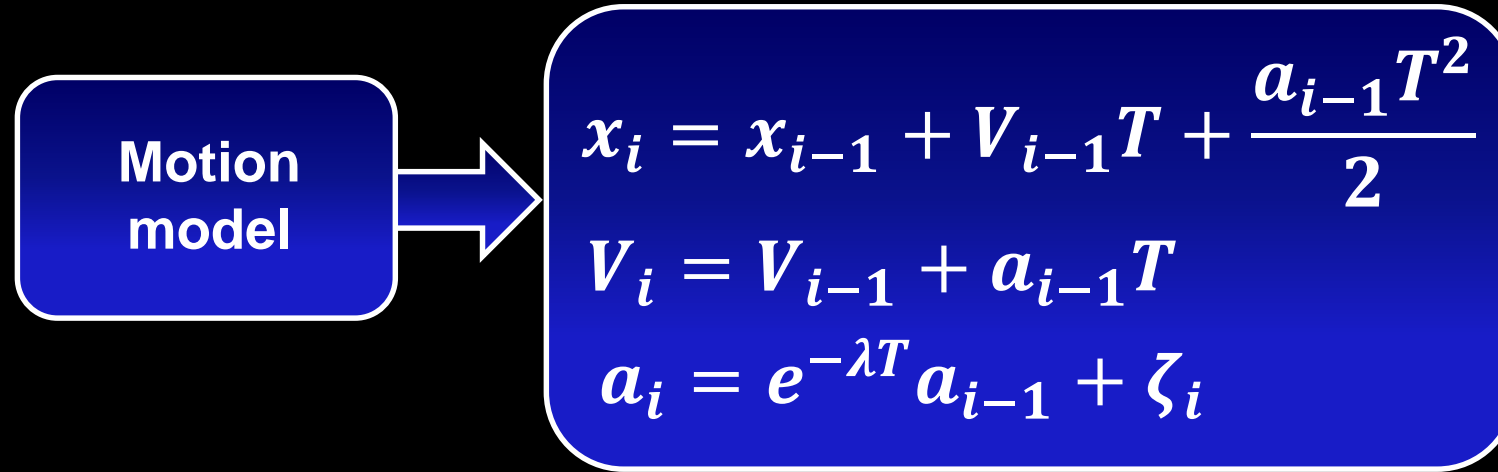
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graph LR; A[Motion model] --> B["
$$x_i = x_{i-1} + V_{i-1}T + \frac{a_{i-1}T^2}{2}$$
 $a_i = e^{-\lambda T}a_{i-1} + \zeta_i$ "]
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$$x_i = x_{i-1} + V_{i-1}T + \frac{a_{i-1}T^2}{2}$$

$$V_i = V_{i-1} + a_{i-1}T$$

$$a_i = e^{-\lambda T}a_{i-1} + \zeta_i$$

Moving object which trajectory is disturbed by correlated random acceleration



Beside estimation of coordinate x_i and velocity V_i , Kalman filter will also estimate the dynamics of correlated acceleration a_i

State space model

