Kalman Filter

Philipp Schön (5121059)
Constantin Thein (5121017)

Mean

$$\mu = \frac{1}{N}\sum_{n=1}^{N} V_n = \frac{1}{5}(5+5+10+10+10) = 8cent$$

Variance

	Player 1	Player 2	Player 3	Player 4	Player 5	Mean
Team A	1.89m	2.10m	1.75m	1.98m	1.85m	1.914m
Team B	1.94m	1.90m	1.97m	1.89m	1.87m	1.914m

$$x_n - \mu = x_n - 1.914m$$

	Player 1	Player 2	Player 3	Player 4	Player 5
Team A	-0.024m	0.186m	-0.164m	0.066m	-0.064m
Team B	0.026m	-0.014m	0.056m	-0.024m	-0.044m

Variance

	Player 1	Player 2	Player 3	Player 4	Player 5
Team A	-0.024m	0.186m	-0.164m	0.066m	-0.064m
Team B	0.026m	-0.014m	0.056m	-0.024m	-0.044m

$$(x_n - \mu)^2 = (x_n - 1.914m)^2$$

	Player 1	Player 2	Player 3	Player 4	Player 5
Team A	0.000576m^2	0.034596m^2	0.026896m^2	0.004356m^2	0.004096m^2
Team B	0.000676m^2	0.000196m^2	0.003136m^2	0.000576m^2	0.001936m^2

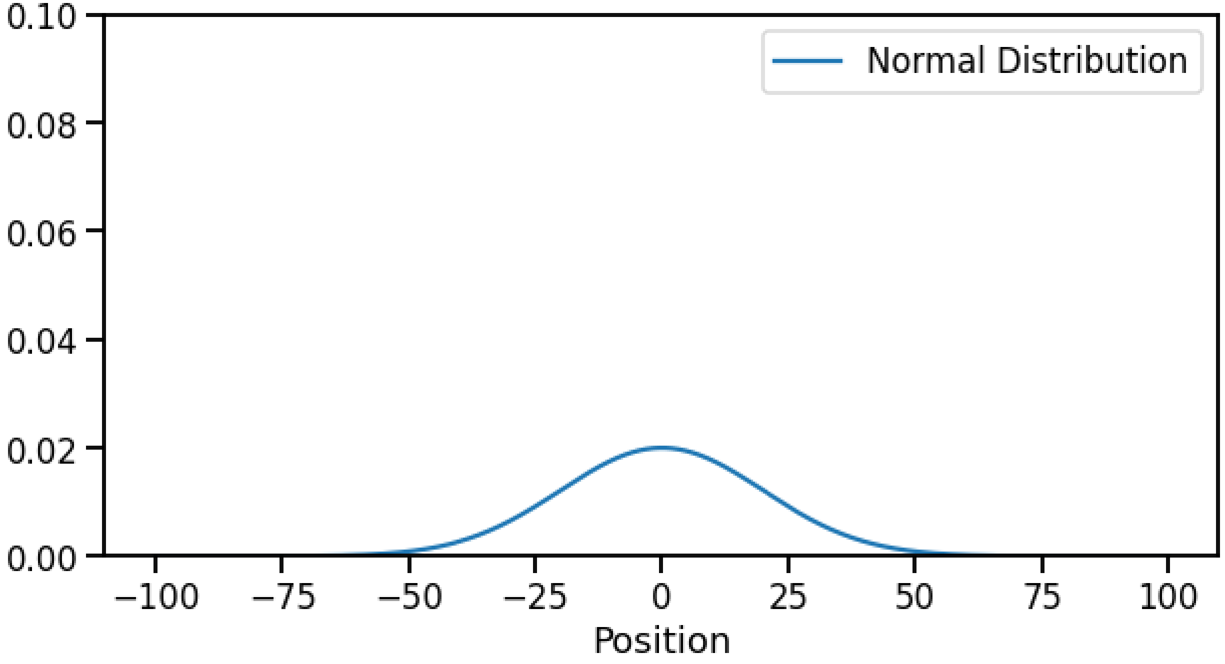
Variance

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

$$\sigma_A^2 = \frac{1}{N}\sum_{n=1}^{N}(x_{A_n} - \mu)^2 = \frac{1}{5}(0.000576 + 0.034596 + 0.026896 + 0.004356 + 0.004096) = 0.014m^2$$

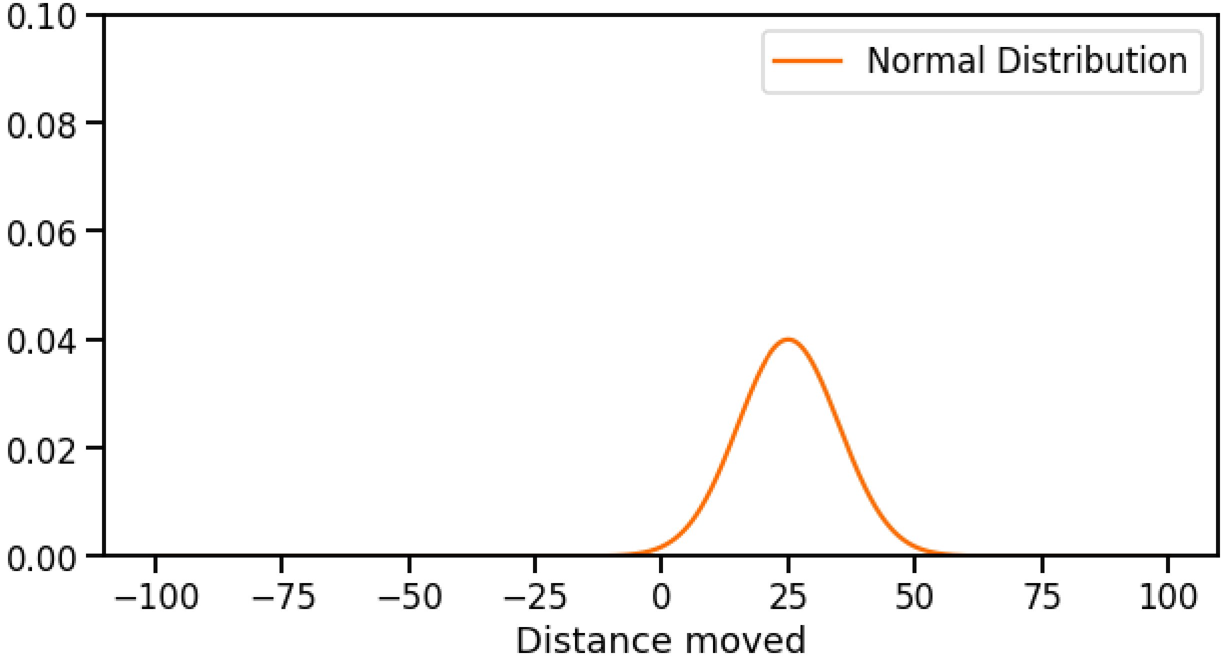
$$\sigma_B^2 = \frac{1}{N}\sum_{n=1}^{N}(x_{B_n} - \mu)^2 = \frac{1}{5}(0.000676 + 0.000196 + 0.003136 + 0.000576 + 0.001936) = 0.0013m^2$$

Kalman-Filter explained



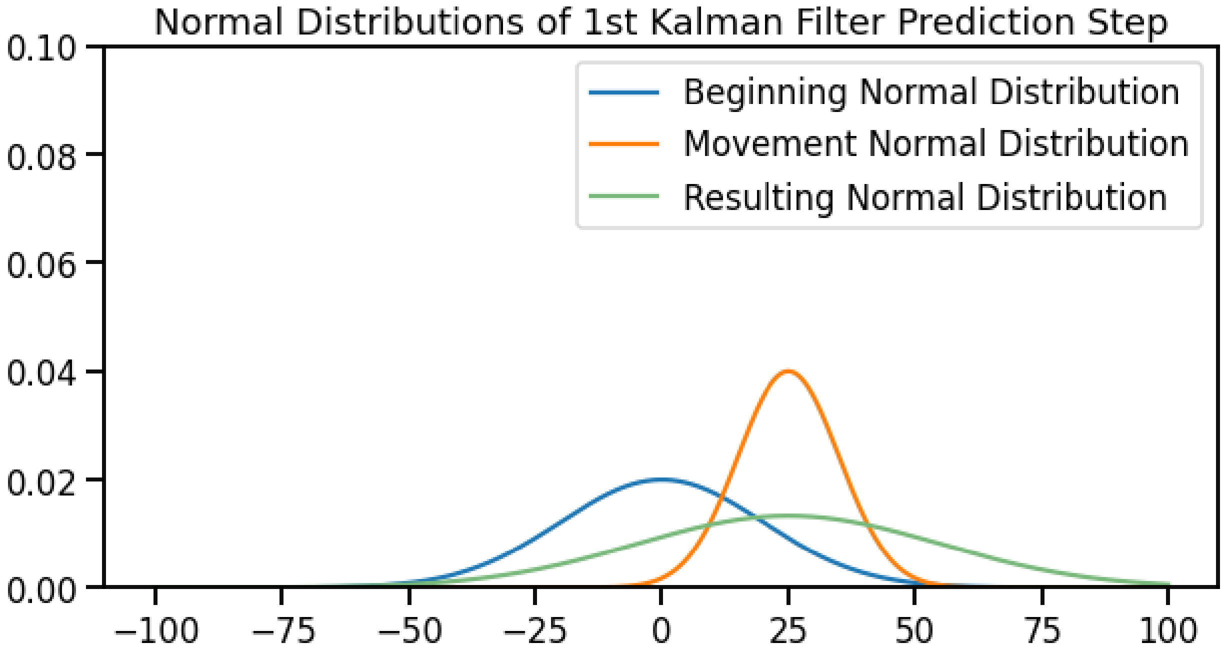

```
mean = 0.0
var  = 20.0
```

Kalman-Filter explained




```
meanMove = 25.0
varMove  = 10.0
```

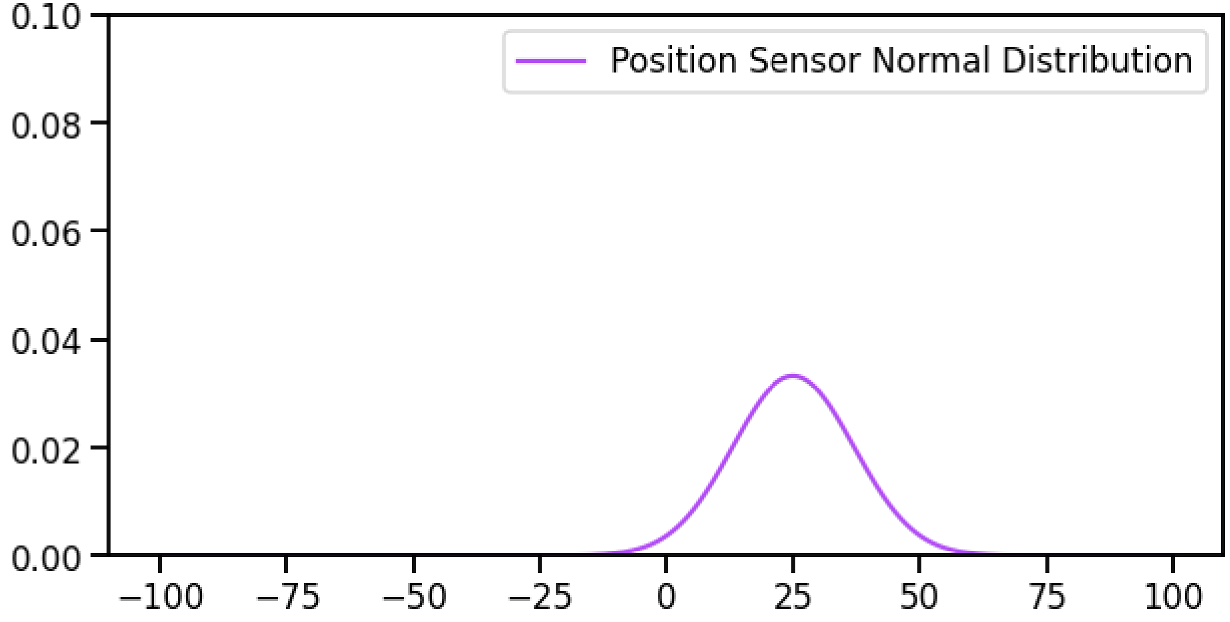
Kalman-Filter explained



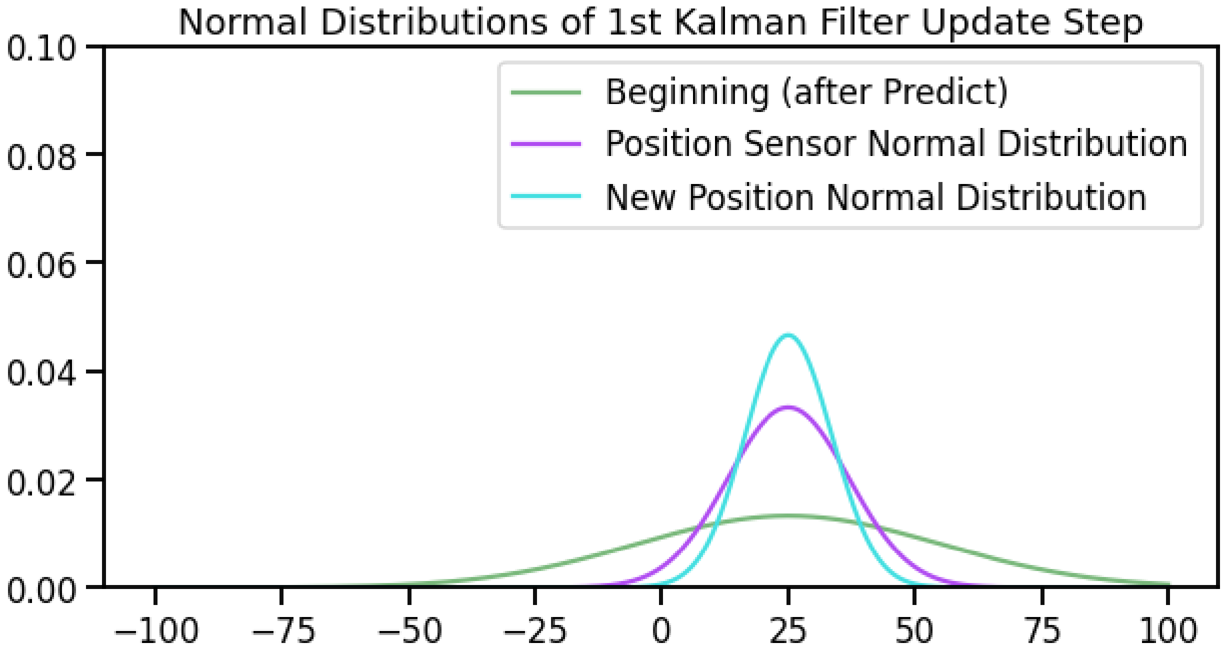
$$\mu_{new} = \mu_0 + \mu_{move}$$

$$\sigma^2_{new} = \sigma^2_0 + \sigma^2_{move}$$

Kalman-Filter explained



Kalman-Filter explained



$$\sigma^2_{new} = \frac{1}{\frac{1}{\sigma^2_{old}} + \frac{1}{\sigma^2_{Sensor}}}$$

$$\mu_{new} = \frac{\sigma^2_{Sensor} \cdot \mu_{old} + \sigma^2_{old} \cdot \mu_{Sensor}}{\sigma^2_{old} + \sigma^2_{Sensor}}$$

Kalman Flowchart

Prediction

Project the state ahead

$$x_{k+1} = Ax_k + Bu_k$$

Project the error covariance ahead

$$P_{k+1} = AP_kA^T + Q$$

Correction

Compute the Kalman Gain

$$K_k = P_kH^T(HP_kH^T + R)^{-1}$$

Update the estimate via measurement

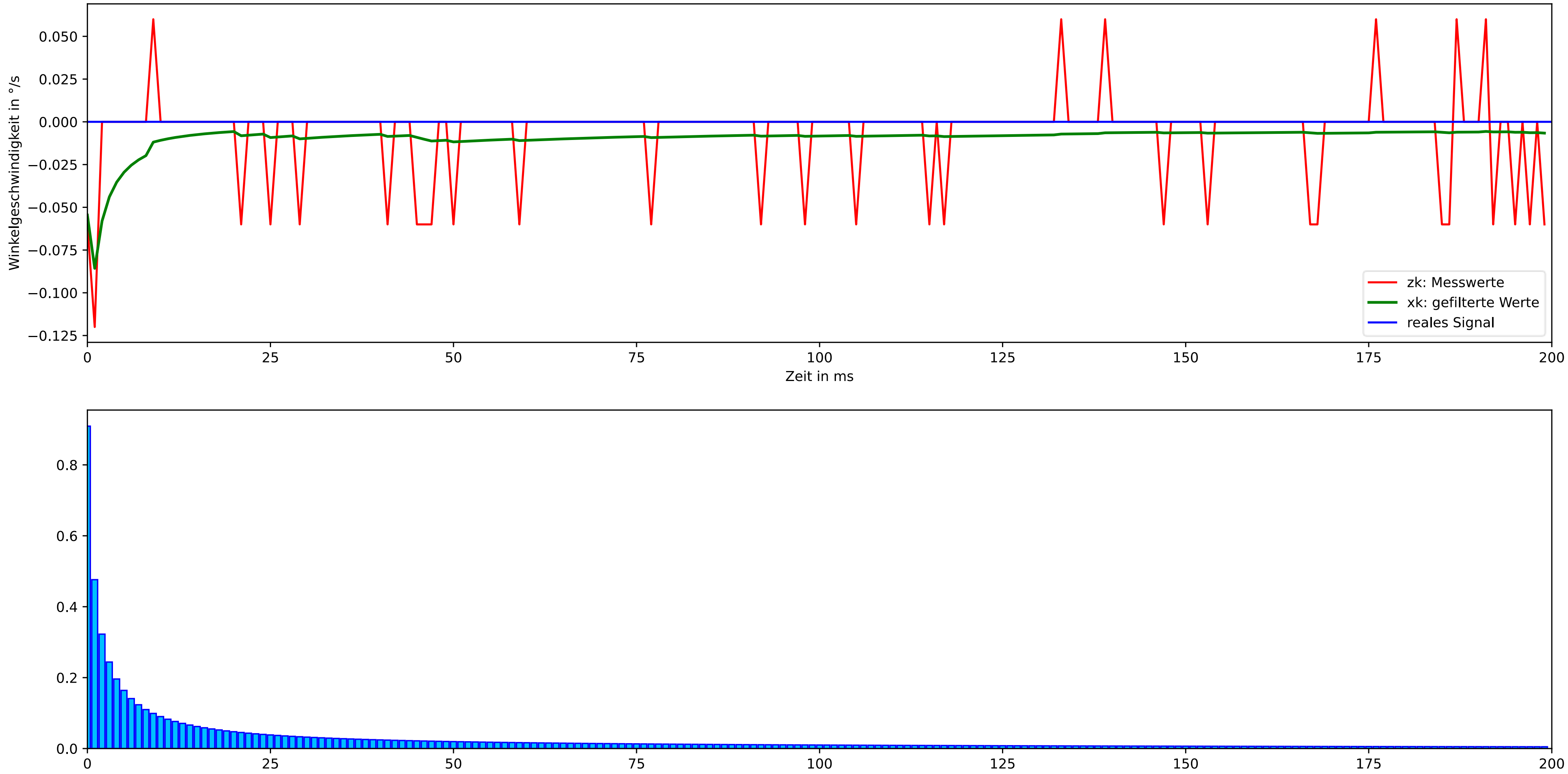
$$x_k = x_k + K_k(z_k - Hx_k)$$

Update the error covariance

$$\mathrm{P}_k = (I - K_kH)P_k$$

Initialize R, P, Q once

Normal sensor noise



External noise