

UKF:

$$\begin{aligned} x_{k+1} &= f(x_k) + v_k \\ z_k &= h(x_k) + w_k \end{aligned}$$

① Augmentation:  $x^a = \begin{bmatrix} x \\ v \end{bmatrix}$        $P^a = \begin{bmatrix} P & 0 \\ 0 & Q \end{bmatrix}$

Sigma points:  $X_{k|k}^s = \begin{bmatrix} x_{k|k}^a & \phi x_{k|k}^a + \sqrt{(\lambda+n)P_{k|k}^a} & x_{k|k}^a - \sqrt{(\lambda+n)P_{k|k}^a} \end{bmatrix}$   
 generation  $\lambda+n_a=3$

② Sigma points prediction:  $x_{k+1} = f(x_k, v_k)$

$x_{k+1|k}^p = \begin{bmatrix} * & \dots \end{bmatrix}$

③ 
$$\begin{aligned} x_{k+1|k} &= \sum_{i=1}^{2n_a+1} w_i x_{k+1|k,i}^p \\ P_{k+1|k} &= \sum_{i=1}^{2n_a+1} w_i (x_{k+1|k,i}^p - x_{k+1|k})(x_{k+1|k,i}^p - x_{k+1|k})^T \\ w_i &= \frac{\lambda}{\lambda+n_a}, i=0 \\ w_i &= \frac{1}{2(\lambda+n_a)}, i=1, \dots, 2n_a \end{aligned}$$

$z_{k+1} = h(x_{k+1})$

④ measurement update:  $z_{k+1|k} = \begin{bmatrix} * & \dots \end{bmatrix}$

⑤ 
$$\begin{aligned} z_{k+1|k} &= \sum_{i=1}^{2n_a+1} w_i z_{k+1|k,i} \\ S_{k+1|k} &= \sum_{i=1}^{2n_a+1} w_i (z_{k+1|k,i} - z_{k+1|k})(z_{k+1|k,i} - z_{k+1|k})^T + R \end{aligned}$$

⑥ 
$$\begin{aligned} T_{k+1|k} &= \sum_{i=1}^{2n_a+1} w_i (x_{k+1|k,i} - x_{k+1|k})(z_{k+1|k,i} - z_{k+1|k})^T \\ K_{k+1|k} &= T_{k+1|k} S_{k+1|k}^{-1} \\ x_{k+1|k+1} &= x_{k+1|k} + K_{k+1|k} (z_{k+1} - z_{k+1|k}) \\ P_{k+1|k+1} &= P_{k+1|k} - K_{k+1|k} S_{k+1|k} K_{k+1|k}^T \end{aligned}$$