UKF:

$$x_{k+1} = f(x_k) + v_k$$
$$z_k = h(x_k) + w_k$$

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

Sigma points: $X^s_{k|k} = [\, x^a_{k|k} \;\; x^a_{k|k} + \sqrt{(\lambda+n)P^a_{k|k}} \;\; x^a_{k|k} - \sqrt{(\lambda+n)P^a_{k|k}} \,]$ (generation)

$\lambda + n_a = 3$

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

$$x^p_{k+1|k} = [\, * \;\; \cdots\cdots \;\;]$$

③
$$x_{k+1|k} = \sum_{i=1}^{2n_a+1} w_i \, x^p_{k+1|k,i}$$
$$P_{k+1|k} = \sum_{i=1}^{2n_a+1} w_i \, (x^p_{k+1|k,i} - x_{k+1|k})(x_{k+1|k,i} - x_{k+1|k})^T$$
$$w_i = \frac{\lambda}{\lambda + n_a}, \; i = 0$$
$$w_i = \frac{1}{2(\lambda+n_a)}, \; i = 1, \cdots, 2n_a$$

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

④ measurement update:

$$z_{k+1|k} = [\, * \;\; \cdots\cdots \;\;]$$

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

⑥
$$T_{k+1|k} = \sum_{i=1}^{2n_a+1} w_i \, (x_{k+1|k,i} - x_{k+1|k})(z_{k+1|k,i} - z_{k+1|k})^T$$
$$K_{k+1|k} = T_{k+1|k} \cdot S^{-1}_{k+1|k}$$
$$x_{k+1|k+1} = x_{k+1|k} + K_{k+1|k}(z_{k+1} - z_{k+1|k})$$
$$P_{k+1|k+1} = P_{k+1|k} - K_{k+1|k} \, S_{k+1|k} \, K^T_{k+1|k}$$