# FastSLAM Algorithm – Part 1

**FastSLAM1.0_known_correspondence**$(z_t, c_t, u_t, \mathcal{X}_{t-1})$**:**

*for* $k = 1$ *to* $N$ *do* // *loop over all particles*

  *Let* $\left\langle x_{t-1}^{[k]}, \left\langle \mu_{1,t-1}^{[k]}, \Sigma_{1,t-1}^{[k]} \right\rangle, \ldots \right\rangle$ *be particle* $k$ *in* $\mathcal{X}_{t-1}$

  $x_t^{[k]} \sim p(x_t \mid x_{t-1}^{[k]}, u_t)$ // *sample pose*

  $j = c_t$ // *observed feature*

  *if feature* $j$ *never seen before*

    $\mu_{j,t}^{[k]} = h^{-1}(z_t, x_t^{[k]})$ // *initialize mean*

    $H = h'(\mu_{j,t}^{[k]}, x_t^{[k]})$ // *calculate Jacobian*

    $\Sigma_{j,t}^{[k]} = H^{-1}\, Q_t\, (H^{-1})^T$ // *initialize covariance*

    $w^{[k]} = p_0$ // *default importance weight*

  *else*

# FastSLAM Algorithm – Part 2

*else*

$\langle \mu_{j,t}^{[k]}, \Sigma_{j,t}^{[k]} \rangle = \textit{EKF-Update}(\dots)$ // *update landmark*

$$w^{[k]} = |2\pi Q|^{-\frac{1}{2}} \exp\left\{-\frac{1}{2}(z_t - \hat{z}^{[k]})^T Q^{-1} (z_t - \hat{z}^{[k]})\right\}$$

**measurement cov.** $Q = H\,\Sigma_{j,t-1}^{[k]}\,H^T + Q_t$ **exp. observation**

*endif*

*for all unobserved features* $j'$ *do*

$\langle \mu_{j',t}^{[k]}, \Sigma_{j',t}^{[k]} \rangle = \langle \mu_{j',t-1}^{[k]}, \Sigma_{j',t-1}^{[k]} \rangle$ // *leave unchanged*

*endfor*

*endfor*

$$\mathcal{X}_t = \text{resample}\left(\left\langle x_t^{[k]}, \left\langle \mu_{1,t}^{[k]}, \Sigma_{1,t}^{[k]} \right\rangle, \dots, w^{[k]} \right\rangle_{k=1,\dots,N}\right)$$

*return* $\mathcal{X}_t$

# FastSLAM Algo. – Part 2 (long)

**EKF update**

*else*

$\hat{z}^{[k]} = h(\mu_{j,t-1}^{[k]}, x_t^{[k]})$ // *measurement prediction*

$H = h'(\mu_{j,t-1}^{[k]}, x_t^{[k]})$ // *calculate Jacobian*

$Q = H\ \Sigma_{j,t-1}^{[k]}\ H^T + Q_t$ // *measurement covariance*

$K = \Sigma_{j,t-1}^{[k]}\ H^T\ Q^{-1}$ // *calculate Kalman gain*

$\mu_{j,t}^{[k]} = \mu_{j,t-1}^{[k]} + K(z_t - \hat{z}^{[k]})$ // *update mean*

$\Sigma_{j,t}^{[k]} = (I - K\ H)\Sigma_{j,t-1}^{[k]}$ // *update covariance*

$w^{[k]} = |2\pi Q|^{-\frac{1}{2}}\ \exp\left\{-\frac{1}{2}(z_t - \hat{z}^{[k]})^T\ Q^{-1}\ (z_t - \hat{z}^{[k]})\right\}$ // *importance factor*

*endif*

*for all unobserved features* $j'$ *do*

$\langle \mu_{j',t}^{[k]}, \Sigma_{j',t}^{[k]} \rangle = \langle \mu_{j',t-1}^{[k]}, \Sigma_{j',t-1}^{[k]} \rangle$ // *leave unchanged*

*endfor*

*endfor*

$\mathcal{X}_t = \text{resample}\left(\left\langle x_t^{[k]}, \left\langle \mu_{1,t}^{[k]}, \Sigma_{1,t}^{[k]} \right\rangle, \ldots, w^{[k]} \right\rangle_{k=1,\ldots,N}\right)$

*return* $\mathcal{X}_t$