

# Robótica Móvil

## un enfoque probabilístico

### Fast-SLAM - Notas

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# Pasos de FastSLAM

- Muestrear nueva pose para cada partícula

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

- Calcular el peso de la partícula

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

Medición esperada



Covarianza de la Medición

- Actualizar belief de landmarks observadas (actualización EKF)
- Remuestrear

# FastSLAM 1.0 – Parte 1

```
1:  FastSLAM1.0_known_correspondence( $z_t, c_t, u_t, \mathcal{X}_{t-1}$ ):  
2:      for  $k = 1$  to  $N$  do                                     // loop over all particles  
3:          Let  $\langle x_{t-1}^{[k]}, \langle \mu_{1,t-1}^{[k]}, \Sigma_{1,t-1}^{[k]} \rangle, \dots \rangle$  be particle  $k$  in  $\mathcal{X}_{t-1}$   
4:           $x_t^{[k]} \sim p(x_t \mid x_{t-1}^{[k]}, u_t)$                 // sample pose  
5:           $j = c_t$                                              // observed feature  
6:          if feature  $j$  never seen before  
7:               $\mu_{j,t}^{[k]} = h^{-1}(z_t, x_t^{[k]})$              // initialize mean  
8:               $H = h'(\mu_{j,t}^{[k]}, x_t^{[k]})$                  // calculate Jacobian  
9:               $\Sigma_{j,t}^{[k]} = H^{-1} Q_t (H^{-1})^T$          // initialize covariance  
10:              $w^{[k]} = p_0$                                    // default importance weight  
11:          else
```

# FastSLAM 1.0 – Parte 2

```
11:         else
12:              $\langle \mu_{j,t}^{[k]}, \Sigma_{j,t}^{[k]} \rangle = \text{EKF-Update}(\dots)$  // update landmark
13:              $w^{[k]} = |2\pi Q|^{-\frac{1}{2}} \exp \left\{ -\frac{1}{2} (z_t - \hat{z}^{[k]})^T Q^{-1} (z_t - \hat{z}^{[k]}) \right\}$ 
Covarianza de la Medición ↑  $Q = H \Sigma_{j,t-1}^{[k]} H^T + Q_t$  Medición esperada ↑
14:         endif
15:         for all unobserved features  $j'$  do
16:              $\langle \mu_{j',t}^{[k]}, \Sigma_{j',t}^{[k]} \rangle = \langle \mu_{j',t-1}^{[k]}, \Sigma_{j',t-1}^{[k]} \rangle$  // leave unchanged
17:         endfor
18:     endfor
19:      $\mathcal{X}_t = \text{resample} \left( \left\langle x_t^{[k]}, \langle \mu_{1,t}^{[k]}, \Sigma_{1,t}^{[k]} \rangle, \dots, w^{[k]} \right\rangle_{k=1, \dots, N} \right)$ 
20:     return  $\mathcal{X}_t$ 
```

# FastSLAM 1.0 – Parte 2 (detalle)

```
11:         else
12:              $\hat{z}^{[k]} = h(\mu_{j,t-1}^{[k]}, x_t^{[k]})$  // measurement prediction
13:              $H = h'(\mu_{j,t-1}^{[k]}, x_t^{[k]})$  // calculate Jacobian
14:              $Q = H \Sigma_{j,t-1}^{[k]} H^T + Q_t$  // measurement covariance
15:              $K = \Sigma_{j,t-1}^{[k]} H^T Q^{-1}$  // calculate Kalman gain
16:              $\mu_{j,t}^{[k]} = \mu_{j,t-1}^{[k]} + K(z_t - \hat{z}^{[k]})$  // update mean
17:              $\Sigma_{j,t}^{[k]} = (I - K H) \Sigma_{j,t-1}^{[k]}$  // update covariance
18:              $w^{[k]} = |2\pi Q|^{-\frac{1}{2}} \exp \left\{ -\frac{1}{2} (z_t - \hat{z}^{[k]})^T \right.$   

                $\left. Q^{-1} (z_t - \hat{z}^{[k]}) \right\}$  // importance factor
19:         endif
20:         for all unobserved features  $j'$  do
21:              $\langle \mu_{j',t}^{[k]}, \Sigma_{j',t}^{[k]} \rangle = \langle \mu_{j',t-1}^{[k]}, \Sigma_{j',t-1}^{[k]} \rangle$  // leave unchanged
23:         endfor
24:     endfor
25:      $\mathcal{X}_t = \text{resample} \left( \left\langle x_t^{[k]}, \left\langle \mu_{1,t}^{[k]}, \Sigma_{1,t}^{[k]} \right\rangle, \dots, w^{[k]} \right\rangle_{k=1,\dots,N} \right)$ 
26:     return  $\mathcal{X}_t$ 
```