Olasılıksal Robotik

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Haritalama

- Occupancy Grid Mapping (Bilinen Konum ile Haritalama)

$$p\left(m \middle| z_{1:t}, x_{1:t}\right)$$

$$m = \{\mathbf{m_i}\}$$

- $\mathbf{m_i}$ uzayı temsil eden hücreler

$$p(\mathbf{m_i} = 1) \Longrightarrow \text{hücre dolu}$$

Haritalama

- Binary Bayes Filtresi gibi ele alınabilir

$$p\left(m \middle| z_{1:t}, x_{1:t}\right) = \prod_i p\left(\mathbf{m_i} \middle| z_{1:t}, x_{1:t}\right)$$

Occupancy Grid Mapping

1: **Algorithm occupancy_grid_mapping**($\{l_{t-1,i}\}, x_t, z_t$):

2: *for all cells* $\mathbf{m}_i$ *do*
3: *if* $\mathbf{m}_i$ *in perceptual field of* z_t *then*
4: $l_{t,i} = l_{t-1,i} + \textbf{inverse\_sensor\_model}(\mathbf{m}_i, x_t, z_t) - l_0$
5: *else*
6: $l_{t,i} = l_{t-1,i}$
7: *endif*
8: *endfor*
9: *return* $\{l_{t,i}\}$

Occupancy Grid Mapping

- **Log odds representation :**
  - 0 ve 1 civarı doluluk olasılığındaki sayısal stabilite

$$\ell_{t,i} = \log \frac{p\left(\mathbf{m_i} \middle| z_{1:t}, x_{1:t}\right)}{1 - p\left(\mathbf{m_i} \middle| z_{1:t}, x_{1:t}\right)}$$

Occupancy Grid Mapping

- Log odds representation → hücre doluluk olasılığı

$$p\left(\mathbf{m_i} \middle| z_{1:t}, x_{1:t}\right) = 1 - \frac{1}{1 + e^{\ell_{t,i}}}$$

Occupancy Grid Mapping

- Log odds representation ilklendirme

$$\ell_0 = \log \frac{p\left(\mathbf{m_i} = 1\right)}{p\left(\mathbf{m_i} = 0\right)} = \log \frac{p\left(\mathbf{m_i} = 1\right)}{1 - p\left(\mathbf{m_i} = 1\right)} = 0$$

Occupancy Grid Mapping

- **Inverse Sensor Model**

$$\text{inverse sensor model}\,(\mathbf{m_i}, x_t, z_t) = \log \frac{p\left(\mathbf{m_i} \middle| z_t, x_t\right)}{1 - p\left(\mathbf{m_i} \middle| z_t, x_t\right)}$$

Occupancy Grid Mapping

1: **Algorithm inverse_range_sensor_model**($\mathbf{m}_i, x_t, z_t$):

2: *Let* x_i, y_i *be the center-of-mass of* $\mathbf{m}_i$

3: $r = \sqrt{(x_i - x)^2 + (y_i - y)^2}$

4: $\phi = \text{atan2}(y_i - y, x_i - x) - \theta$

5: $k = \text{argmin}_j \, |\phi - \theta_{j,\text{sens}}|$

6: *if* $r > \min(z_{\max}, z_t^k + \alpha/2)$ *or* $|\phi - \theta_{k,\text{sens}}| > \beta/2$ *then*

7: *return* l_0

8: *if* $z_t^k < z_{\max}$ *and* $|r - z_t^k| < \alpha/2$

9: *return* l_{occ}

10: *if* $r \leq z_t^k$

11: *return* l_{free}

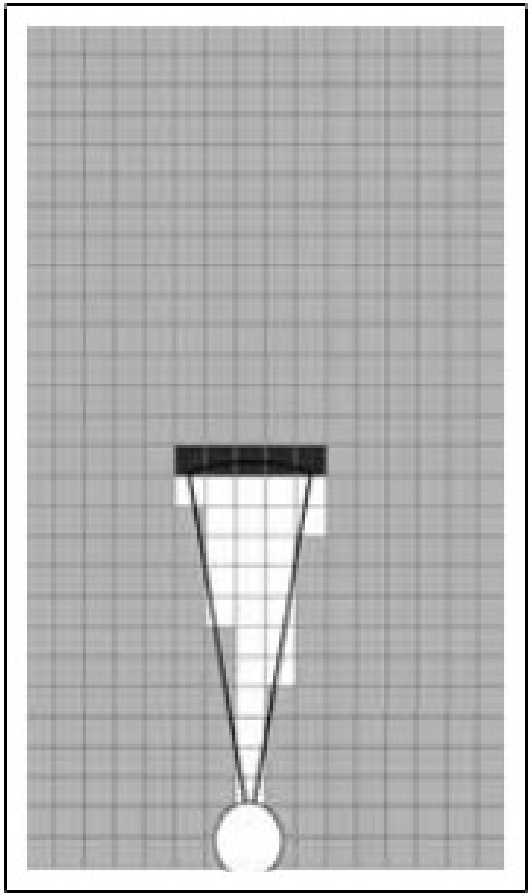
12: *endif*

$$\ell_{occ} > \ell_0$$

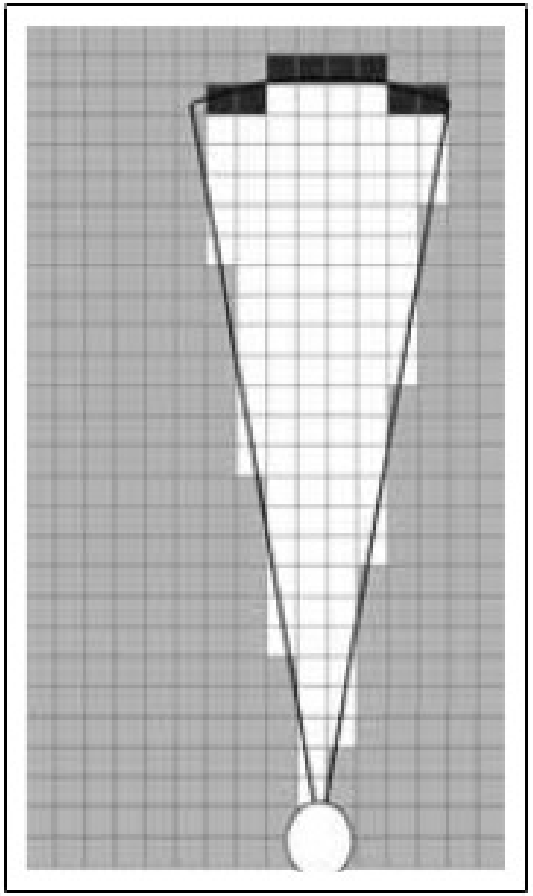
$$\ell_{free} < \ell_0$$

Occupancy Grid Mapping

(a)



(b)



Occupancy Grid Mapping -Max. A Posteriori