Trabalho #4

Simular os algoritmos apresentados no capítulo 6 do livro [Thrun etal:2006] .

Tabelas com os algoritmos:

Algorithm beam_range_finder_model(z_t, x_t, m):

  $q = 1$
  for $k = 1$ *to* K *do*
    compute z_t^{k*} *for the measurement* z_t^k *using ray casting*
    $p = z_{\text{hit}} \cdot p_{\text{hit}}(z_t^k \mid x_t, m) + z_{\text{short}} \cdot p_{\text{short}}(z_t^k \mid x_t, m)$
      $+ z_{\text{max}} \cdot p_{\text{max}}(z_t^k \mid x_t, m) + z_{\text{rand}} \cdot p_{\text{rand}}(z_t^k \mid x_t, m)$
    $q = q \cdot p$
  return q

Algorithm learn_intrinsic_parameters(Z, X, m):

  repeat until convergence criterion satisfied
    for all z_i *in* Z *do*
      $\eta = [\, p_{\text{hit}}(z_i \mid x_i, m) + p_{\text{short}}(z_i \mid x_i, m)$
        $+ p_{\text{max}}(z_i \mid x_i, m) + p_{\text{rand}}(z_i \mid x_i, m)\,]^{-1}$
      calculate z_i^*
      $e_{i,\text{hit}} = \eta\, p_{\text{hit}}(z_i \mid x_i, m)$
      $e_{i,\text{short}} = \eta\, p_{\text{short}}(z_i \mid x_i, m)$
      $e_{i,\text{max}} = \eta\, p_{\text{max}}(z_i \mid x_i, m)$
      $e_{i,\text{rand}} = \eta\, p_{\text{rand}}(z_i \mid x_i, m)$

    $z_{\text{hit}} = |Z|^{-1} \sum_i e_{i,\text{hit}}$
    $z_{\text{short}} = |Z|^{-1} \sum_i e_{i,\text{short}}$
    $z_{\text{max}} = |Z|^{-1} \sum_i e_{i,\text{max}}$
    $z_{\text{rand}} = |Z|^{-1} \sum_i e_{i,\text{rand}}$
    $\sigma_{\text{hit}} = \sqrt{\frac{1}{\sum_i e_{i,\text{hit}}} \sum_i e_{i,\text{hit}} (z_i - z_i^*)^2}$
    $\lambda_{\text{short}} = \frac{\sum_i e_{i,\text{short}}}{\sum_i e_{i,\text{short}}\, z_i}$
  return $\Theta = \{z_{\text{hit}}, z_{\text{short}}, z_{\text{max}}, z_{\text{rand}}, \sigma_{\text{hit}}, \lambda_{\text{short}}\}$

Algorithm likelihood_field_range_finder_model(z_t, x_t, m):

  $q = 1$
  for all k *do*
    if $z_t^k \neq z_{\text{max}}$
      $x_{z_t^k} = x + x_{k,\text{sens}} \cos\theta - y_{k,\text{sens}} \sin\theta + z_t^k \cos(\theta + \theta_{k,\text{sens}})$
      $y_{z_t^k} = y + y_{k,\text{sens}} \cos\theta + x_{k,\text{sens}} \sin\theta + z_t^k \sin(\theta + \theta_{k,\text{sens}})$
      $dist = \min_{x',y'} \left\{ \sqrt{(x_{z_t^k} - x')^2 + (y_{z_t^k} - y')^2} \,\middle|\, \langle x', y' \rangle \text{ occupied in } m \right\}$
      $q = q \cdot \left(z_{\text{hit}} \cdot \textbf{prob}(dist, \sigma_{\text{hit}}) + \frac{z_{\text{random}}}{z_{\text{max}}} \right)$
  return q

Algorithm landmark_model_known_correspondence(f_t^i, c_t^i, x_t, m):

  $j = c_t^i$
  $\hat{r} = \sqrt{(m_{j,x} - x)^2 + (m_{j,y} - y)^2}$
  $\hat{\phi} = \text{atan2}(m_{j,y} - y, m_{j,x} - x)$
  $q = \textbf{prob}(r_t^i - \hat{r}, \sigma_r) \cdot \textbf{prob}(\phi_t^i - \hat{\phi}, \sigma_\phi) \cdot \textbf{prob}(s_t^i - s_j, \sigma_s)$
  return q

Algorithm sample_landmark_model_known_correspondence(f_t^i, c_t^i, m):

  $j = c_t^i$
  $\hat{\gamma} = \text{rand}(0, 2\pi)$
  $\hat{r} = r_t^i + \textbf{sample}(\sigma_r)$
  $\hat{\phi} = \phi_t^i + \textbf{sample}(\sigma_\phi)$
  $x = m_{j,x} + \hat{r} \cos\hat{\gamma}$
  $y = m_{j,y} + \hat{r} \sin\hat{\gamma}$
  $\theta = \hat{\gamma} - \pi - \hat{\phi}$
  return $(x \;\; y \;\; \theta)^T$

Material disponível no Moodle

- Notas de aula.

Referências

[1] Sebastian Thrun, Wolfram Burgard & Dieter Fox
Probabilistic robotics.
MIT Press, **2006**.
Link: http://probabilistic-robotics.informatik.uni-freiburg.de/

[2] Howie Choset, Kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki & Sebastian Thrun
Principles of Robot Motion. Theory, Algorithms, and Implementations.
MIT Press, **2005**.
Link: http://biorobotics.ri.cmu.edu/book/

Contém uma descrição detalhada do filtro de Kalman e do EKF.

[3] Gregor Klancar, Andrej Zdešar, Sašo Blažic & Igor Škrjanc
Wheeled Mobile Robotics. From Fundamentals Towards Autonomous Systems.
Butterworth-Heinemann, **2017**.
Link: http://booksite.elsevier.com/9780128042045/manuscript.php

Contém códigos em Matlab.

Apresentações

- Os grupos terão cerca de 20 minutos para fazer as apresentações.
- As apresentações serão realizadas na seguinte data:

16/dez (4a. feira)

Avaliação do trabalho

Preparar e enviar por email:

1. Relatório contendo a descrição dos algoritmos, resultados das simulações e discussão dos resultados.
2. Códigos dos programas utilizados nas simulações.
3. Slides preparados para a apresentação do trabalho.

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