SC42050 Literature Assignment

Particle Filters for Tracking Robots

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Nowadays robots are more and more autonomous; one interesting problem for them is how to localize themselves based on their knowledge of the environment. One idea is to use Particle filters. After reading (Arulampalam et al., 2002) answer the following questions:

1. Perform a short literature survey on Particle Filters applications, in particular try to find out:
   - who is using Particle Filters in Robotics applications (which universities? which applications?);
   - which version of the filter they are using.
2. Discuss the trade off between degeneracy and loss of diversity.
3. Suppose the dynamical system of a robot is

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

   where x is the state, u is the control input, z is the measurement output, $f(.,.)$ and $h(.,.)$ are two nonlinear functions, while w and v are generic non-Gaussian noise terms. Write explicitly the SIR filter for a suitable choice of $p(x_k|x_{k-1})$ and $p(z_k|x_k)$ (you can also refer to (Thrun et al., 2005)).
4. What does the eq. (64) means? What is a Dirac's delta function? What are the differences between eq. (64) and eq. (73)? $K_h(.)$ is a basis function, what are other possible basis functions that you can use in eq. (73)?
5. Why, in your opinion, Particle Filters have not been taught to you so extensively as Kalman Filters?

References

Arulampalam, M. S., Maskell, S., Gordon, N., and Clapp, T. (2002). A tutorial on particle filters for online nonlinear/non-Gaussian Bayesian tracking. *IEEE Transactions on Signal Processing*, 50(2):174–188.

Thrun, S., Burgard, W., and Fox, D. (2005). *Probabilistic Robotics*. MIT Press.