Part A:
Title: Particle Filters and Their Applications
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List of topics covered in the lecture:
Particle filters
The use of particle filters in SLAM (FastSLAM)
The use of particle filters in rover fault diagnosis

Part B:
Verma, Vandi, Geoff Gordon, Reid Simmons, and Sebastian Thrun. "Particle Filters for Rover Fault Diagnosis," IEEE Robotics & Automation Magazine special issue on Human Centered Robotics and Dependability, June 2004. http://www-2.cs.cmu.edu/~reids/papers/vandi_ieeeras.pdf

Thrun, Sebastian. "A Probabilistic Online Mapping Algorithm for Teams of Mobile Robots," International Journal of Robotics Research, Vol. 20, 2001. http://robots.stanford.edu/papers/thrun.maps-multi.pdf

Part C:

Particle filters are a powerful tool for approximating any probability distribution by sampling that distribution with a large number of 'particles'. They are particularly useful when the distribution is nonlinear and/or highly disjointed. In this lecture, we will explain what particle filters are, and then show how they are applicable in the areas of SLAM and rover fault diagnosis. In SLAM, particles can be used to represent both the robot's position and the location of all landmarks (or the occupancy map, if one is used in place of landmarks). This is better than the usual method of representing this information using Gaussians, which cannot represent the possibility that the robot is likely in one of two separate locations. In rover fault diagnosis, particle filters are used for estimating which state the robot is in, including possible fault states. However, the problem is that large numbers of particles must be drawn to ensure that low-probability states (e.g., fault states) are sampled. We will present some of the recent techniques that have been developed to deal with this problem.

Part D:

http://web.mit.edu/mwalter/www/PRRG/Papers/fastslam.pdf
Montemerlo, Michael, Sebastian Thrun, Daphne Koller, and Ben Wegbreit. "FastSLAM: A Factored Solution to the Simultaneous Localization and Mapping Problem," Proceedings of the AAAI National Conference on Artificial Intelligence, 2002.

This paper describes the much-used FastSLAM algorithm, which uses particle filters to do SLAM with landmarks (as opposed to the occupancy maps used in the paper in part B).

Stachniss, Cyrill, Giorgio Grisetti, and Wolfram Burgard. "Recovering Particle Diversity in a Rao-Blackwellized Particle Filter for SLAM After Actively Closing Loops." Proceedings of the IEEE International Conference on Robotics and Automation, 2005.
http://www.informatik.uni-freiburg.de/~stachnis/pdf/stachniss05icra.pdf

This paper discusses how to deal with the problem of the particle filter becoming overly confident after successfully closing a loop by recovering the particle diversity.

Sebastian Thrun, John Langford, and Vandi Verma. "Risk Sensitive Particle Filters," Proceedings of Neural Information Processing Systems (NIPS), December, 2001.
http://www-2.cs.cmu.edu/afs/cs/user/vandi/www/papers/nips01.ps

This paper describes in more detail the risk-sensitive particle filter technique used in the Verma paper on rover fault diagnosis in Part 2.

Richard Dearden, Frank Hutter, Reid Simmons, Sebastian Thrun, Vandi Verma, and Thomas Willeke. "Real-time Fault Detection and Situational Awareness for Rovers: Report on the Mars Technology Program Task," To appear in the Proceedings of IEEE Aerospace Conference, March 2004.
http://www-2.cs.cmu.edu/afs/cs/user/vandi/www/papers/dearden-et-al-1209.pdf

This paper describes how particle filters are used to perform state estimation on the K-9 rover at NASA Ames Research Center and the Hyperion rover at CMU.

Part E:
Kaijen will develop/present the part of the lecture on particle filters in general.
Henry will develop/present the part of the lecture on the application of particle filters to SLAM.
Jason will develop/present the part of the lecture on the application of particle filters to rover fault diagnosis.

Part F:
We will demonstrate the use of particle filters in SLAM and in localization using two demos from the Robotics and State Estimation lab at the University of

Washington. We plan to show the "Global robot localization using sonar sensors" demo and the
"Rao-Blackwellised particle filters for laser-based SLAM" demo found at the following website:
http://www.cs.washington.edu/ai/Mobile_Robotics/mcl/