ASEN 6519 Special Topics – Spring 2016
Algorithms for Aerospace Autonomy

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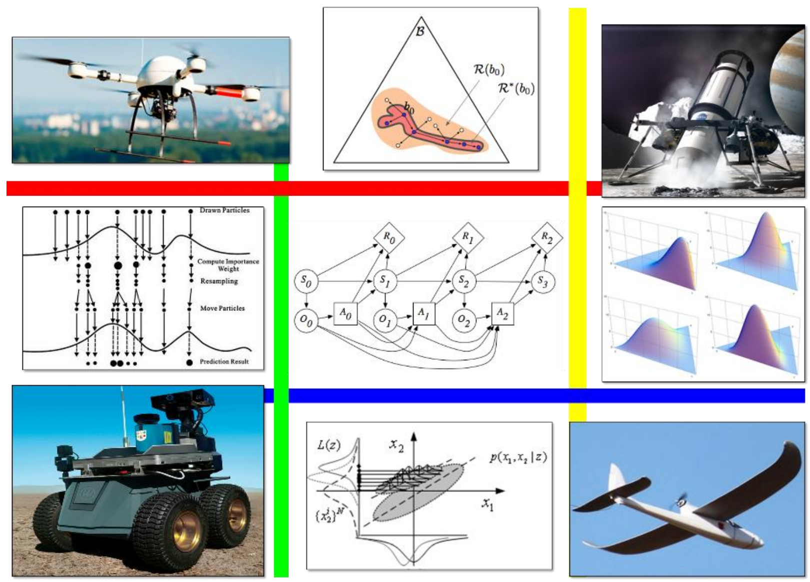
Course Time and Location

Tue/Thur, 3:30-4:45pm, ECCR 135



Course Summary

Autonomous systems adapt and make decisions on their own under uncertainty. Statistical algorithms for learning and reasoning are thus crucial for designing modern autonomous unmanned aerospace systems, and are being adopted by many other disciplines as well. This advanced graduate course will cover modern statistical learning and AI techniques that allow autonomous systems to successfully reason under uncertainty.
It will build on fundamental probability, estimation, and optimization theory, and emphasize current/future applications driving academic and industrial research. Topics will include:

- **probabilistic models:** discrete-time Markov models, Bayesian networks, Markov random fields, factor graphs, decision graphs, Bayesian nonparametric models (Gaussian/Dirichlet processes);
- **batch/offline learning** for pattern recognition and `static'/fixed decision making;
- **approximate inference methods**: extended/unscented Kalman filters, variational Bayes, Markov Chain Monte Carlo/Gibbs sampling, importance sampling and particle filters;
- **sequential optimal decision making and dynamic programming**: Markov decision processes (MDPs), partially observable MDPs (POMDPs);
- **online learning**: multi-armed bandits, reinforcement/inverse reinforcement learning;
- **possible advanced topics** (as time/interest permits): distributed multi-agent reasoning; human-autonomy interaction; explainable/introspective AI; sparse/zero-shot learning; planning as inference; Markov logic networks; Bayesian deep learning

Students will complete programming projects that could, for instance, serve as the basis for autonomy aboard an unmanned ground/air/space vehicle, or that connects to their own research. Students will also discuss work from leading robotics and AI conferences and journals.

Text: Mykel Kochenderfer, *Decision Making Under Uncertainty: Theory and Application*, MIT Press, 1st edition, 2015.

Prerequisites: Previous coursework in probability/statistics (e.g. ASEN 5044), formal linear algebra and control theory (e.g. ASEN 5014); strong familiarity with a technical programming language for assigned course projects (e.g. Matlab/Octave, Python, C/C++, Java, R, or similar).