Study Circle on Robot Learning and Control

Fall Semester, 2014

Department of Automatic Control, LTH, Lund University, Sweden

LUND UNIVERSITY

Format of the Course

- Study circle — participants meet once every week to discuss a certain aspect of robot learning and control.
- A number of key articles and book chapters presented on course homepage before each meeting.
- Simulation task related to the subject prepared before the meeting.
- Before each meeting, one participant is assigned in advance to prepare a summary of the studied material and the simulation results.
- Presentation with approximately 10 slides (10–15 min) as introduction to the discussion during the meeting.

Examination

- Active participation in the weekly discussion meetings.
- Project in the end of the course, preferably related to the participant's research project.
- Project presented at a seminar with the other participants in the group.
- Completed course gives 7.5 hp.
- Anders Robertsson (`anders.robertsson@control.lth.se`) is the examiner of the course.

Administration

- One meeting per week:
  Thursdays, 10.15–12.00.
- Course homepage:
  `http://www.control.lth.se/Education/...`
  `DoctorateProgram/robot-learning.html`
- Approximately 8-10 meetings expected (including project presentations).
- Assignment of responsible for presentation during discussion meeting each week.

Preliminary Content of the Course

Classes of Learning Algorithms:

- ▶ Supervised learning
- ▶ Unsupervised learning
- ▶ Reinforcement learning

Algorithms and Model Structures:

- ▶ Bayesian learning, regression
- ▶ Learning by human demonstration
- ▶ Support vector machines
- ▶ Gaussian processes, Gaussian mixture models
- ▶ Hidden Markov models, Markov decision processes
- ▶ Artificial neural networks
- ▶ Clustering, Classification

Preliminary Content of the Course (cont'd)

State Estimation and Modeling:

- ▶ Kalman filters and extensions of these (EKF, UKF)
- ▶ Particle filters
- ▶ System identification

Control Algorithms with Learning:

- ▶ Adaptive control
- ▶ Iterative learning control
- ▶ Iterative feedback tuning

Content of the Course (cont'd)

Presentation of the participants' slides with suggestion for topics to be discussed during the course.

Literature

- Bishop, C. M.: *Pattern Recognition and Machine Learning*. New York: Springer-Verlag, 2006.

- Murphy, K. P.: *Machine learning: A probabilistic perspective*. Cambridge, MA: MIT Press, 2012.

- Hastie, T., Friedman, J., & Tibshirani, R.: *The elements of statistical learning*. New York: Springer-Verlag, 2002.

- Rasmussen, C. E. & Williams, C. K. I.: *Gaussian Processes for Machine Learning*. Cambridge, MA: MIT Press, 2006.

- Thrun, S., Burgard, W., & Fox, D.: *Probabilistic Robotics*. Cambridge, MA: MIT Press, 2006.

- Additional journal and conference papers on robotics learning and control — input from course participants collected on course homepage.