Electrical and Computer Engineering

COURSE OFFERING
Spring 2010

ECE596C-085 "Cognitive Mobile Robotics"

Friday 1:00 – 3:30 p.m.
Classroom: TBA

Instructor: M. Anthony Lewis, Ph.D.ECE
Ian Fasel, Ph.D. Computer Science Jean-Marc Fellous, Ph.D. Psychology

Course Description: Good solutions have been developed for classical robot problems, with more problems falling each day as computer processors have continued an exponential increase in power. Many robotic solutions where originally inspired by biology. Robotics formed beautiful theoretical frameworks around biological inspiration. Now, these solutions have been exported to numerous areas in the biological sciences and have had a major impact on theoretical models.

Robotics is now poised to do something similar with cognitive mobile robotics." Inspired somewhat by biological system, the goal is to create robots that can seamlessly work in with people in the real world. Such platforms also provide a rich environment for simulation as well as mimicry of human and animal intelligence. And will inform new theoretical models in science. With new and better processors, vast new research areas are unfolding before our eyes. This class will leverage the power of fast processors, mathematics and biologically understanding.

In addition to engineering students, we welcome students from CS, Philosophy, Psychology and other science related fields. A mix of student will lead to a robust, inter-disciplinary exchange of ideas and perspectives. Student from outside disciplines who are interested in this topic but lack many of the prerequisites are invited to audit the class and participate in discussions.

Topics will be selected from :

1. Cognitive Maps in Animals and Robot Models.
2. Sensory driven legged locomotion in humans an animals.
3. Neurorobotics (Neural models+ Robotics systems).
4. Robot Architecture: Sensing Perception Planning and Action, Behavioral based, Biorobotics.
5. Social Robotics: A_ective Computing, Robot Emotions, Contrasted with theory of human emotion.
6. Probabilistic Methods in robotics. Kalman Filter, Extended Kalman Filter, Unscented Kalman Filter, Particle _lters, Bayesian Localization, Probabilistic Road maps, Simultaneous Localization and mapping (SLAM). Contrasted with representation by the hippocampus in animals.
7. Motion Perception: Optic(al) ow, Time to collision, ego motion estimation, monocular SLAM, heading direction, obstacle detection, a_ordances, algorithms. Human studies.
8. Stereopsis: Vergence, disparity, algorithms. Human stereopsis.
9. Learning and Adaptation: Parameter tuning, Reinforcement learning, biologically plausible rules.
10. Decision making, Partially Observable Markov Decision Processes (POMDPs)
11. Synthesis of Action. Cortical decision processes.
12. Software Methods: Open source middleware, Microsoft Robotics Studio.