TCSS 437 Mobile Robotics
Model Syllabus
(Approved: 25 May 2012)

Catalog Description

Explores algorithmic design options for motion control, navigation, and obstacle avoidance in mobile autonomous robots. Introduces pertinent principles from artificial intelligence and embedded real-time systems. Students construct robots from kits and program them to demonstrate sophisticated behaviors. Prerequisite: 2.0 or above in TCSS 360; 2.0 or above in TCSS 422.

Preconditions

From TCSS 360:

- Participate effectively in a team to develop a solution based on client requirements while using appropriate tools for facilitating teamwork.

From TCSS 422

- Solve basic inter-process communications/coordination problems
- Demonstrate the scheduling process in a multi-processing environment

Course Student Learning Goals (to be added to syllabus handed out to students)

- Describe behavior-based robotics and contrast this with other approaches to robotics
- Describe several architectures used to implement behavior based robotics
- Design and develop control algorithms in a demonstration robot given a description of required behaviors
- Solve problems related to arbitration among multiple, concurrent behaviors

CES/CSS Degree Student Learning Outcomes that this course contributes to (to be added to syllabus handed out to students). Note that the use of the term *outcome* here instead of *goal* is simply for purposes of integration with ABET and has no other semantic import.

- an ability to apply knowledge of computing and mathematics appropriate to the discipline;
- an ability to analyze a problem, identify and define the computing requirements appropriate to its solution;
- an ability to design, implement and evaluate a computer-based system, process, component, or program to meet desired needs;
- an ability to function effectively on teams to accomplish a common goal;
- an ability to use current techniques, skills, and tools necessary for computing practice.

UWT Student Learning Goals that this course contributes to (to be added to syllabus handed out to students)

Inquiry and Critical Thinking
Students will acquire skills and familiarity with modes of inquiry and examination from diverse disciplinary perspectives, enabling them to access, interpret, analyze, quantitatively reason, and synthesize information critically.

Topics covered

- Motor control
- Signal processing (from noisy sensor input)
- Options for the physical design of mobile robotics (wheels, tracks, legs, other options)
- Deliberative control versus reactive control systems
- Schemes for arbitration among multiple concurrent behaviors
- Concepts relevant to robotic navigation (mapping, localization, obstacle avoidance, etc.)

Additional Information

A note of caution: Elective courses in artificial intelligence and embedded systems are not prerequisite to this course and such prior knowledge should not be assumed. Aspects of these subjects pertinent to this course must be introduced as needed. Also, this course is open to both CES and CSS students; therefore, the design of the course should not disadvantage either group of students.

Textbooks recently used:

Behavior-Based Robotics, Ronald C. Arkin, 1998, ISBN: 0-262-01165-4

Lego MINDSTORMS NXT Power Programming: Robotics in C 2nd edition, John C. Hansen, 2009, ISBN: 978-09738649-7-7

Other references:

Vehicles: Experiments in Synthetic Psychology, Valentino Braitenberg, 1986, ISBN: 978-0262521123

Robot Programming – A Practical Guide to Behavior-Based Robotics, Joseph L. Jones, 2004, ISBN: 978-0-07-142778-4

The Robotics Primer, Maja J Mataric, MIT Press, 2007, ISBN 978-0-262-63354-3

Introduction to Autonomous Mobile Robots second edition, Siegwart, Nourbakhsh, and Scaramuzza, 2011, ISBN: 978-0-262-01535-6

Intelligence Unleashed, Creating Lego NXT Robots with Java, Brian Bagnall, 2011, ISBN: 978-0-9868322-0-8

Optional topics which could be included based on instructor interest/experience/expertise:

- History of robotics
- Comparison of robots in popular fiction to the current state of robotics
- Ethical/Societal/Economic implications of the design and use of robots
- Current research and development (Where is it happening? Who is doing it?)
- Learning versus designed behaviors (adaptive control)
- The future of robotics – current and future challenges