CEG499/699-11: Selected Topics
Intelligent Sensor Systems
Spring 2002
Time: Tu-Th 7:00-8:15PM
Room: 154 Russ Engineering Center

Instructor: Ricardo Gutierrez-Osuna
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Catalog Description: Not available for "Selected Topics" courses.

Prerequisites: No formal course prerequisites will be enforced. However, the students are expected to have basic knowledge on each of the following areas:

- Computer Science: programming in a high-level language
- Statistics: mean, variance, probability functions
- Circuit Analysis: voltage, current, RLC circuits

Textbook: No textbook is required. Lecture notes will be posted on the course website when available.

Recommended:

- R. H. Bishop, Learning with LabVIEW, Addison Wesley, 1999
- D. Hanselman and B. Littlefield, Mastering MATLAB 5, Prentice Hall, 1998

Additional References:

- R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, Wiley, 2001
- J. Brignell and N. White, Intelligent Sensor Systems, Revised Ed., IOP, 1996
- R. Frank, Understanding Smart Sensors, 2nd Ed., Artech, 2000
- R. Pallás-Areny and J. G. Webster, Sensors and Signal Conditioning, Wiley, 1991

Course Objectives: The objectives of this course are to:

- Introduce the fundamentals of intelligent sensor systems: sensors, instrumentation and pattern analysis.
- Provide the students with an integrative and multidisciplinary experience by building a complete multi-sensor intelligent system
- Allow the students to develop instrumentation, data acquisition and pattern analysis software using modern equipment and software tools

Course Outcomes: Upon satisfactory completion of the course, the student will be able to design, analyze and implement:

- Basic instrumentation and signal conditioning circuits for sensors
- Virtual instrumentation and data acquisition software for sensors and actuators
- Pattern analysis algorithms for multi-sensor systems

Lecture Outline

- SENSORS
  - Primary sensing principles and measurement variables
  - Sensor performance characteristics and terminology
- INSTRUMENTATION
  - Transducer measurement circuits
  - Signal conditioning circuits
  - Data conversion: DAC, ADC
  - Virtual instrumentation with LabVIEW
- PATTERN ANALYSIS
  - Introduction to Statistical Pattern Recognition
  - Dimensionality reduction
  - Classification
  - Validation
  - Data analysis with MATLAB
- INTELLIGENT SENSOR SYSTEMS
  - Structure, definitions and concepts
  - Advanced processing and control techniques
  - Smart sensors
  - Case study: the “electronic nose”
  - The future of intelligent sensor systems

Laboratory Outline

- LAB I: Sensor interfacing
  - Temperature sensor calibration
  - Gas sensor isothermal excitation
- LAB II: Data acquisition
  - Virtual instrument and GUI design
  - Analog and digital I/O
  - File I/O
- LAB III: System integration
  - Control of electromechanical actuators
  - Flow injection assembly
  - Integration of control, DAQ and GUI modules
- LAB IV: Pattern analysis
  - Signal preprocessing
  - Dimensionality reduction
  - Classification
- LAB V: Advanced sensor excitation
  - Pulse Width Modulation
  - Temperature cycling
  - Analysis of performance

Grading: The course grade will be the weighted sum of three grades (laboratory and two tests). Grading will be straight scale (90-100 A, 80-89 B, 70-79 C, 60-69 D, below 60 F). These numeric thresholds may be lowered due to clustering, but will not be raised.

	Weight (%)
Laboratories	60
Midterm	15
Final Exam	25

Laboratory: There will be five lab assignments, distributed every one to two weeks. These will emphasize the implementation (hardware and software) of material presented in class. Laboratory assignments will be done in groups of two to four students.

Tests: There will be a midterm exam and a final exam. All tests will be closed-books, closed--notes. One double-sided, hand-written sheet (8.5 x 11") will be allowed. Tests will emphasize new material.

Missed Tests: Missed tests can only be made up in case of emergency or work conflicts, and will require supporting documentation. Whenever possible, these issues should be discussed with the instructor prior to the conflicting date.

Collaboration vs. Academic Dishonesty: Students are encouraged to exchange ideas and form study groups to discuss the course material, prepare for lab assignments and tests. However, discussions between different groups regarding laboratory assignments should be kept at the conceptual level. Academic dishonesty will not be tolerated in class, in the laboratory or during examinations. For a list of examples of cheating see Section X in the Code of Student Conduct in the online Wright State University Student Handbook: (http://www.wright.edu/studsvcs/handbook/03_02.html.)

Tentative Schedule

	Date	Topic (Calendar)	Assignments
Week 1	3/26	Course Introduction	
	3/28	Sensors I	
Week 2	4/1	Sensors II	
	4/4	Instrumentation I	
Week 3	4/9	Instrumentation II	Lab 1 Sensor interfacing
	4/11	Instrumentation III	
Week 4	4/16	LabVIEW	Lab 2 Data acquisition
	4/18	Instrumentation IV	
Week 5	4/23	Midterm Review	
	4/25	Midterm Exam	Lab3 System integration
Week 6	4/30	Pattern analysis I	
	5/2	Pattern analysis II	
Week 7	5/7	MATLAB	Lab4 Pattern analysis
	5/9	Pattern analysis III	
Week 8	5/14	Pattern analysis IV	
	5/16	Pattern analysis V	
Week 9	5/21	Intelligent Sensor Systems I	Lab 5 Advanced sensor excitation
	5/23	Intelligent Sensor Systems II	
Week 10	5/28	Intelligent Sensor Systems III (Last day of class)	
	5/30	Final Review	
Week 11	6/4	Final Exam* (No class)	
	6/6	(No class)	

**Final exam will be held Tuesday, June 4, 2002, from 7:45 to 9:45PM in Russ 154*