

Title: EEE 517 Sensors and Machine Learning

Pre-Requisites: Basic Circuits and Systems. Basic Signals and Systems, Basic Programming skills.

Course Open to: Fulton Electrical, Computer and Energy Engineering (ECEE) or CEN graduate student. Students from other Fulton Schools Graduate programs may enroll with instructor consent.

Hybrid Course / i-Course**Contact Information and Office Hours**

Andreas Spanias, GWC 411F, 480 965 1837. Monday, Wednesday Friday 2-4PM. Others by appointment made by email. For remote students through skype hours at a_spanias.

Catalog Description:

Integrated sensor devices and algorithms; microphone arrays, chemical sensing, mobile sensing; accelerometers and magnetometers, nanopore sensors, and flexible and patch sensors. Signal pre-processing for sensors; feature extraction; image sensing; voice processing; filters; frequency analysis; autocorrelation; principal components; k means algorithm; sensor fusion; neural nets; applications to health, security and mobile systems.

Course Overview

This one credit special topics seminar course will cover sensor devices and algorithms in an integrative manner. The course will focus mostly on applications of sensors and machine learning. Applications will cover the use of integrated sensors and algorithms in health, sustainability, surveillance, internet of things, and others. Sensor topic coverage will include surveys of: microphone arrays, chemical sensing, imaging, mobile sensing with accelerometers and magnetometers, nanopore sensors, and flexible and patch sensors. On the algorithm side the seminar course will cover the utility of machine learning and signal processing in improving the fidelity and precision of sensors.

Course Objectives

- To introduce students to sensor and machine learning applications and enable them to engage in sensor related projects and research.
- To introduce students to the essentials of signal processing required to remove noise and improve signal classification.
- To survey current and emerging applications of sensors and machine learning.

Expected Learning Outcomes

- Students understand basic sensor devices, their properties and their applications.
- Students understand the utility of machine learning and signal processing in sensor related applications.
- Students are able to program and run feature extraction and clustering algorithms on sensor data.

Assignments

- Students view weekly seminars on sensor and machine learning
- Students respond to a quiz for each and every seminar;
- Students perform a signal processing and filter design exercise using MATLAB submit a report with data and graphs and remarks.
- Students perform a machine learning exercise and prepare signal processing and filter design exercise using MATLAB. Students submit a report with data and graphs and remarks.
- Student propose a paper to study and present in class. (Students record their presentation (voice-over-power point) and instructor posts on blackboard and evaluates).

- Final Report – 4 IEEE style pages including references.

Grading

- Quizzes on seminar content 20% (weekly)
- Two Computer Exercises 20% (3rd week and 10th week)
- Project presentation and final report 60% (final week of semester)
- Late assignments will not be accepted except in formally documented emergencies or illness.

Credits: 1

Credit Content: Engineering and Science, Interdisciplinary applications

Course Instructors: A. Spanias (spanias@asu.edu)
Jennifer Blain Christen (jennifer.blainchristen@asu.edu)

Other Instructors: P. Turaga, V. Berisha

Book: Research and survey papers that will be provided by the instructors

Tools: Java-DSP, MATLAB, Python

COURSE DESCRIPTION

Topics:

- Intro to signal processing (video streamed module)
- Analog to digital converters for sensors
- Accelerometers and magnetometers
- Intro to Sensor design (video streamed module)
- Flexible sensors (seminar) for health monitoring
- Microphone and antenna Array principles
- Signal processing for nanopore sensors
- Sensors for water quality
- Breathing and respiratory sensors /Metabolism applications
- Chemical sensors / CO2 sensing
- Intro to Machine Learning (video streamed module)
- Intro to Neural Nets and deep learning
- Intro to K means and SVM for sensor systems
- Introduction to sensor fusion
- Introduction to Kalman filtering
- Social Implications of deploying sensor technology
- Various IoT applications of sensors machine learning
- Sensor localization applications

Absence & Make-Up Policies

This is an i-Course. All seminars are recorded. All lectures must be viewed without exception and a quiz on each lecture must be taken. A final presentation is mandatory. If no final presentation is made, the grade of “E” will be assigned.

Classroom Behavior

This is an i-Course and all seminars are recorded. In occasional face-to-face seminars in a recording studio all cell phones and pagers must be off. The use of recording devices is not permitted. Any violent or threatening conduct by an ASU student in this class will be reported to the ASU Police Department and the Office of the Dean of Students. [Preceding statement is required.]

Academic Integrity

All students in this class are subject to ASU's Academic Integrity Policy (available at <http://provost.asu.edu/academicintegrity>) and should acquaint themselves with its content and requirements, including a strict prohibition against plagiarism. All violations will be reported to the Dean's office, who maintain records of all offenses. Students are expected to abide by the FSE Honor Code (<http://engineering.asu.edu/integrity/>). Specific rules for this class are [specify rules on permissible collaboration, use of on-line resources, etc.]. Avoid assessment strategies that promote academic dishonesty (such as unproctored online or take-home exams as a large fraction of the grade).

Disability Accommodations

Suitable accommodations will be made for students having disabilities and students should notify the instructor as early as possible if they will require same. Such students must be registered with the Disability Resource Center and provide documentation to that effect.

Sexual Discrimination

Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at <https://sexualviolenceprevention.asu.edu/faqs>.

As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, <https://eoss.asu.edu/counseling>, is available if you wish discuss any concerns confidentially and privately.

Any information in this syllabus (other than grading and absence policies) may be subject to change with reasonable advance notice.

All contents of these lectures, including written materials distributed to the class, are under copyright protection. Notes based on these materials may not be sold or commercialized without the express permission in writing by the instructor. [Note: Based on [ACD 304-06](#).]