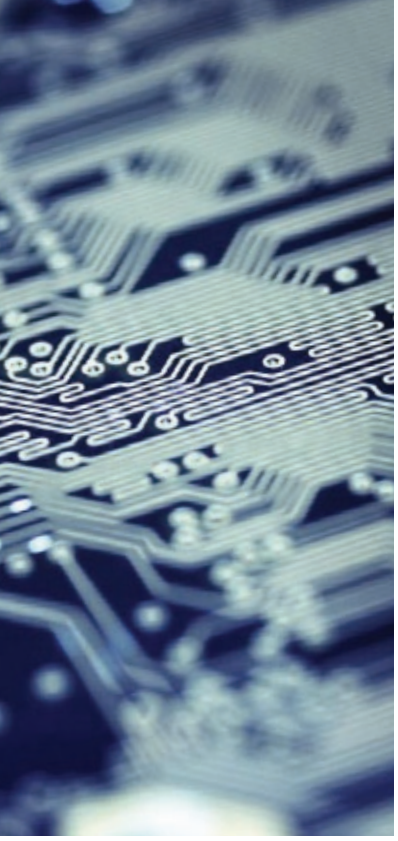

MIE1453: INTRODUCTION TO SENSORS AND SENSOR NETWORKS

Course Instructor: Ardevan Bakhtari, PhD

This course will provide students with practical knowledge on sensor network design including sensor selection, calibration, digitization, and digital signal processing. Students will be introduced to theory and operation of various sensor technologies and their applications. Commonly used transducers such as chemical, mechanical, and magnetic as well as the more advanced organic and nuclear transducers are discussed. This course will also cover linear and non-linear multi-parameter calibration. Digitization, and a survey of digital signal processing techniques will be discussed with practical application of commonly used digital filters. Special focus will be placed on optimal design of sensor networks and multi-sensor data fusion. There will be a design project to enforce the lessons learned in class on sensor calibration and digital signal processing.

NOTE: Lecture format will include 2 hours of theory and 1 hour of case study and class discussion.

COURSE BREAKDOWN

Introduction to Sensing Principles:

This is an introduction to the field of sensors and sensor networks.

- Sensors vs transducers
- Types of sensor
- Commonly used sensors for various applications
- Sensor networks

Sensor Characteristics

- Static and Dynamic characteristics
- Linear and non-linear calibration
- Response and recovery time of first and second order systems

Signal Digitization and Interpretation

- Signal digitization and recording
- Digital noise filtration
    1. Introduction to digital filters
    2. State-Space Filters
    3. Frequency-domain filters

Sensor Network Optimization

- Selecting complimentary, redundant sensors, optimization of sensor positioning and configuration
- Intelligent dynamic sensor networks

Recommended Text (Not Required):

"Handbook of Modern Sensors: Physics, Designs, and Applications" Fifth Edition, Jacob Fraden, Springer, 2016.

Note: The course will use material from multiple sources; the suggested text is best used as a general reference guide.

Course Project

Students are provided with a sensor platform that includes a variety of sensors to measure temperature, humidity, pollutants, noise, and EMF. Students must develop a device that will measure and recognize various environmental parameters. Students must utilize lessons learned in the course including sensor calibration, digital signal processing, and signal interpretation to complete the project.

Course Marking Scheme

Midterm 20%
Project 40%
Final Exam 40%

Project Marking Scheme

Calibration report 10%
Final Report 20%
Final Demonstration 10%