EECE 6340 - Stochastic Systems, Estimation and Control – Fall 2024

Meeting Times: TuTh 3:30-4:45 pm

Meeting Place: Wehr Chemistry 003

Instructor: Prof. Edwin E. Yaz

Office Hours: TuTh 1:45-3:30 pm in person. Alternatively, you can send e- mail to Edwin.Yaz@Marquette.edu to make an appointment at another time.

Required Text: None. Class notes will be posted on D2L.

Software: MATLAB will be used. It is available at http://www.marquette.edu/its/help/matlab/ (at no cost to Marquette Students).

Prerequisites: Linear algebra and basic probability (stochastic processes will be briefly introduced at the beginning of the course)

Course Goals:

This course is designed to give graduate students the ability to model probabilistic dynamical behavior with stochastic systems, analyze the behavior of linear time-invariant and time-varying systems by computer simulation and analytical means, to construct various filters (including the Extended Least Squares, Kalman Filter, H-infinity filter, Extended Kalman Filter, Extended Luenberger Observer and State Dependent Riccati Equation Estimator) for state and parameter estimation using noisy and incomplete measurements for linear and nonlinear systems and measurement models, and to design optimal controllers based on quadratic criteria for linear stochastic systems. Most of the coverage will involve smoothing, filtering and prediction involving stochastic time series in state space form having data analytics in mind.

Specific Objectives:

By the end of this course, the students should know:

1. how to arrive at a stochastic dynamical system model based on either a physical description of dynamics and characterization of disturbances or from input / output data from an unknown system
2. how to analyze the performance of stochastic dynamical systems by computer simulation or analytical means
3. how to use parametric optimization to arrive at optimal state and parameter estimators
4. how to analyze given filter/estimator designs for performance, computational cost, robustness, consistency, resilience, etc.
5. how to extend filtering results to nonlinear system and measurement models

6. how to design quadratic optimal controllers with incomplete and noisy state information.

7. how to apply stochastic modeling, estimation and control tools in various problems ranging from chemical sensing, power systems, radar tracking, to intrusion detection in cyber-physical systems, battery state of charge estimation and target tracking based on videos.

Attendance Policy:

Attendance is not required but highly encouraged, because of the very high correlation between attendance and performance in this class. You should not use any digital device for non-course related activities during lectures (Internet browsing, texting, Facebooking, tweeting, etc.) that prevent you from engaging with the class and distracting other students.

A Statement from the Office of Disability Services: Students with disabilities may be entitled to accommodation and/or academic adjustments designed to give them equal access to the university's resources. The procedures guiding the accommodations process are detailed at the Office of Disability Services website http://www.marquette.edu/disability-services/ Please contact the ODS as early as possible in the semester. If the accommodations are approved, the instructor will receive a letter from ODS describing the accommodations; the student will then work together with the instructor to incorporate the accommodations as needed.

Performance Assessment:

Performance assessment will be based on weekly homework assignments (80%) and a comprehensive exam (20%). Although you are encouraged to work in teams, the homework is to be considered as an honors exam, where each individual is expected to turn in independently prepared homework solutions. For **The Honor Code and Honor Policy**, you are strongly urged to visit the MU sites: (http://bulletin.marquette.edu/undergrad/academicregulations/ and http://www.marquette.edu/provost/integrity-index.php). The following grade scale will be used:

Grade Scale: [a, b) => $a \leq x < b$	
[94, 100]	A
[90, 94)	A-
[86, 90)	B+
[82, 86)	B
[78, 82)	B-
[74, 78)	C+
[70, 74)	C
Below 70	F