ME 697Y SYLLABUS - SPRING 2022

Data-driven Science for Modeling, Pattern Recognition, Optimization and Control

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Here are ways to get information about changes in this course.

Course Web Site: http://engineering.purdue.edu/ME697Y/

Instructor:	Professor Yung C. Shin 494-9775 ME G082 Email: shin@ecn.purdue.edu
Lecture Hours:	Tue. and Thur., 10:30am-11:45am, Synchronous Online: https://purdue.webex.com/meet/shin
Office Hours:	Mon. and Wed., 11:00am-12:00pm
Course Objective:	A unified and unique mathematical treatment of various data-driven techniques with soft computing for constructing intelligent systems, in modeling, optimization and control. The course covers the theory and applications of neural networks, fuzzy logic, machine learning, optimization and control strategies based on data without explicit physical models in developing intelligent systems with examples and practical applications. The course also demonstrates concepts through simulation examples and practical experimental results. Case studies are also presented from each field to facilitate understanding.
Required Texts:	*Intelligent Systems - Modeling, Optimization and Control*, by Yung C. Shin and Chengying Xu, CRC Press, Taylor & Francis Group, 2009
Grading:	short assignments = 50 % final project = 50 %
Prerequistes	ME375 or equivalent in classical control theory Some familiarity in modern control theory based on state-space representation
Programming skills	Matlab or C language-based programming
Purdue's Honor Pledge	see the link *Purdue's Honor Pledge*

Course outline:

Topic	Number of Lectures

Intelligent Modeling via Machine Learning (4.5 wks)

1. Introduction of soft computing techniques
2. Fuzzy logic systems; fuzzy sets, inferencing, fuzzy relation models, Tagaki-Sugeno models
3. Neural networks: various neural network paradigms, training methods, deep neural networks such as convolution neural networks
4. Neuro-fuzzy systems for modeling of non-linear systems
5. Modeling of dynamical systems

Optimization (2.5 wks)

1. Model-based forward optimization
2. Optimization methods: GA, Evolutionary algorithms, particle swarm optimization, etc.
3. Classifiers: Support vector machine
4. Application of model-based optimization to numerical examples
5. Application of model-based optimization scheme to practical problems

Intelligent Control (4 wks)

1. Neural control
2. Rule-based fuzzy control
3. Model-based fuzzy control
4. Stability analysis: passivity theorem, small gain theorem, Liapunov theorem
5. Fuzzy control for SISO nonlinear systems
6. TS fuzzy control: optimal control
7. Fuzzy control application to practical problems

Multivariate Systems and Applications (4 wks)

1. Intelligent control for MISO nonlinear systems
2. Knowledge-based multivariabe fuzzy control
3. Model-based multivariate fuzzy control
4. TS fuzzy control of systems with uncertainties