IEEE GUEST LECTURE SERIES

Monday January 29, 2020, 11am-noon

Music 206 (M206)

Title: Deep Neural Network for Modeling and Control of Complex Nonlinear Systems

Abstract: A deep **adaptive online neural network based control** scheme that has been proposed for the tracking control of a nonlinear bioprocess with unknown internal dynamics will be presented. The deep neural network (DNN) controller exhibits self-learning capability and does not require explicit learning phase hence generates immediate control for class of nonlinear system. A feedback linearization controller along with a DNN based function approximation is proposed for a nonlinear lutein production bioprocess. The setpoint trajectory to yield maximum lutein production is efficiently tracked by the proposed online NN based adaptive controller.

Also, the deep neural networks **(DNN) based online optimal adaptive control** of a class of affine nonlinear systems with uncertain dynamics is introduced. The proposed approach uses two DNNs to solve the optimal regulation over infinite time horizon of nonlinear discrete time systems with known control coefficient matrix and unknown system internal dynamics. The weights of DNN that approximate the cost function referred to as critic NN and the actor DNN which generate the control signal are updated iteratively at every sampling instant as a function of instantaneous Bellman error. With Lyapunov technique, it is shown that all the generated signals are bounded and the estimated optimal control approaches the optimal input with smaller error. The proposed approach presented using two layered NN can be extended to deep NNs for highly complex nonlinear systems.

Bio: Dr N.Pappa is Professor in the Department of Instrumentation Engineering at MIT Campus, Anna University. She is currently a Fulbright Scholar at Missouri University of Science and Technology, pursuing research on Deep Learning for Modeling and Control. Her research interest includes developing Artificial Neural Network (ANN) based soft sensors, image-based measurement, advanced controllers, realization of soft sensors and controllers in embedded hardware and optimization.

She holds a Ph.D from Anna University, M.Tech from Cochin University and B.E. from Annamalai University. She has excelled in academics throughout and received gold medals in both UG and PG for her academic achievements. She was awarded a project under young scientist FAST TRACK scheme of DST. She has visited foreign countries such as USA, Germany, Australia and Singapore to carry out joint research work and to participate in leading control conferences such as ACC, IFAC, ALCOSP etc.

Dr. Pappa's Fulbright-Nehru project research aims at developing novel deep learning based ANN techniques for modeling and control of bioprocesses which exhibit variability, uncertainty, mechanical and sensor limitations and limited process knowledge. Real time implementation and validation of the proposed advanced scheme with appropriate embedded hardware will greatly improve the performance of bioprocesses and can be extended to other industrial processes.