

COLLEGE OF ENGINEERING

# Control Seminar



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## An Approach to Shared Control for Automated Driving



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**February 12, 2021 @ 3:30 pm - 4:30 pm**  
**Event will take place via Zoom**

**ABSTRACT:** This seminar presents a solution to decision making for automated driving based on Reinforcement Learning (RL) and shared autonomy. Two subtopics are considered: 1) RL-based decision making and 2) shared control between the human driver and the machine. First, we develop a Deep Q-Network (DQN) based decision making algorithm for highway driving. We further present an Actor-Critic RL algorithm for decision making for lane changing maneuvers within a multi-agent learning framework utilizing a Long Short Term Memory (LSTM) recurrent neural network (RNN). We subsequently present an interpretable Actor-Critic RL algorithm using a Fuzzy Inference System (FIS) as a function approximator. For shared control between the human driver and the machine, a Game Theoretical (GT) Model Predictive Control (MPC) approach is used. Two GT based frameworks – noncooperative and cooperative, respectively – are investigated in the context of a realistic driving situation. Finally, a shared control strategy for fully mixed driving authority is proposed considering Time-To-Collision (TTC) and tracking error. In addition, transition between different GT frameworks is studied considering the driving situation. Simulation results for both cooperative and inter-game transition driving illustrate how control authority can be safely shared via the proposed strategy. Finally, future work and additional validation plans are discussed.

**BIO:** Reza Langari is Professor of Mechanical Engineering and JR Thompson Department Head Chair, Engineering Technology and Industrial Distribution in the College of Engineering at Texas A&M University. Dr. Langari received the B.Sc., M.Sc., and Ph.D. degrees from the University of California, Berkeley, CA, USA, in 1981, 1983, and 1991, respectively. He was with Measurex Corp. (1984-1985); Integrated Systems, Inc. (1985-1986); and Insight Development Corporation (1987-1989) prior to starting his academic career at Texas A&M University in 1991. He has since held research positions at NASA Ames Research Center, Rockwell International Science Center, United Technologies Research Center, and the U.S. Air Force Research Laboratory. Dr. Langari's expertise is in the area of computational intelligence, with application to robotics and autonomous systems. He is the author/co-author of four books and over two hundred technical papers.



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