## IEEE Joint Robotics & Automation - Controls Systems (JRACS) Chapter Seminar

# Incorporating Input Saturation for Underactuated Surface Vessel Trajectory Tracking Control


**By Dr. Farbod Fahimi**

Assistant Professor, Mechanical and Aerospace Engineering, University of Alabama Huntsville


University of Alabama Huntsville (UAH), Olin B. King Technology Hall, Room S105
5000 Technology Drive, Huntsville, AL 35899
Thursday March 15, 6:00pm-7:00pm

Soft drinks will be provided

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**Abstract:**

A Nonlinear Model Predictive Controller (NMPC) for trajectory tracking of surface vessels is presented. NMPC calculates the future control inputs based on the present state variables by optimizing a cost function. The fact that cost function incorporates input constraints as well as state errors in determining the control inputs is exploited. This method can be applied to all systems with input saturation. NMPC formulation and derivation of input constraints are presented. Here the controller is designed based on a 3 DOF nonlinear dynamic model of the vessel. The performance of the controller is demonstrated by simulations. A constant speed sine trajectory is defined as desired path and the simulation results for input saturation case show the control inputs (propeller speed and rudder angle of the vessel) remain within the saturation limits in extreme maneuvers, the vessel recovers from saturation. The vessel follows the trajectory very closely when the inputs are not saturated.


**Speaker Bio:**

Dr. Fahimi has over 10 years of research experience in dynamic modeling, system identification, linear and nonlinear controls, with applications to robotic system and autonomous vehicles. He received a PhD degree in Mechanical Engineering on dynamic modeling of flexible multi-body systems in 1999. He has graduated 8 Masters students, and has offered several senior design projects. He is currently supervising several full time and part time graduate students. He has taught several undergraduate and graduate level courses such as Dynamics, Vibrations, System Dynamics, Elasticity, Finite Element Method, Introduction to Robotics, and Advanced Robotics. He has authored a graduate level text book titles: Autonomous Robots; Modeling, Path Planning, and Control.


For more information please contact:
Leandro G. Barajas, Ph.D., PMP, IEEE SM
JRACS Chapter Vice-Chair, L.G.Barajas@ieee.org