Gain Scheduled Model Predictive Control: Design and Implementation

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Model Predictive Control (MPC) has a long history in the field of control engineering. It is one of the few areas that has received on-going interest from researchers in both the industrial and academic communities. Three major aspects of model predictive control make the design methodology attractive to both engineers and academics. The first aspect is the design formulation, which uses a completely multivariable system framework where the performance parameters of the multivariable control system are related to the engineering aspects of the system; hence, they can be understood and 'tuned' by engineers. The second aspect is the ability of method to handle both 'soft' constraints and hard constraints in a multivariable control framework. This is particularly attractive to industry where tight profit margins and limits on the process operation are inevitably present. The third aspect is the ability to perform process on-line optimization.

The model predictive control systems are designed using linear models unless a nonlinear model is explicitly stated. Nonlinear model predictive control is conceptually similar to its linear counterpart except that nonlinear models are deployed for the prediction and optimization. However, because of its computational intensity and complexity, the nonlinear predictive control systems are not as widely applied as its linear counterpart. Instead, the gain scheduled control system techniques have found success in the area of predictive control of nonlinear plants. This one-day short-course will show the four steps involved in the design of a gain scheduled predictive controller: (i) linearization of a nonlinear plant model according to operating conditions; (ii) the design of linear predictive controllers using the family of linear models; (iii) gain scheduled predictive control law that will optimize a multiple model objective function with constraints, which will also ensure smooth transitions (i.e. bumpless transfer) between the predictive controllers; (iv) simulation and experimental validation of the gain scheduled predictive control system with constraints using MATLAB® and Simulink® as a platform. The workshop, based on the speaker's book entitled 'Model Predictive Control System Design and Implementation Using MATLAB' (Springer, 2009) and its upcoming second edition, is suitable for engineers, students and researchers who wish to gain basic knowledge about gain scheduled model predictive control of nonlinear plant in the presence of constraints, as well as understand how to perform real time simulation and implementation using MATLAB® and Simulink® tools.

Bio sketch of the Speaker: **Professor Liuping Wang** received her Ph.D degree in 1989 from the Department of Automatic Control and Systems Engineering, University of Sheffield, UK. Upon completion of her PhD degree, she worked in the Department of Chemical Engineering at the University of Toronto, Canada for eight years in the field of process control. From 1998 to 2002, she worked in the Center for Integrated Dynamics and Control, University of Newcastle, Australia. In February 2002, she joined the School of Electrical and Computer Engineering, RMIT University, Australia where she is a Professor of Control Engineering. She has authored and co-authored more than 190 scientific papers in the field of system identification, PID control, adaptive control, model predictive control, and control technology application to industrial processes. She has authored, co-authored and co-edited several books. Dr Liuping Wang is an associate editor of International Journal of Control, Journal of Process Control, IEEE Transactions on Control System Technologies and a Fellow of Institution of Engineers Australia.