Predictive Repetitive Control: Design, Implementation and Applications

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Abstract: Many signals arising in a wide variety of control systems application domains, such as process control, aerospace and robotics, are periodic or can be approximated as such over a large time interval. The general control problem is to force the plant output to track a periodic reference signal and/or reject periodic disturbances. In the majority of applications, model predictive control is designed to follow constant reference signals and reject disturbances that have predominantly low frequency contents. However, these types of model predictive controllers are not adequate to provide the closed-loop performance required when the reference signals and the disturbances are complex and have periodic components.

This presentation addresses the design and implementation of predictive-repetitive control systems that use the design framework of model predictive control while satisfying the requirements of controlling systems with periodic components. The approach is based on a frequency response decomposition technique which detects the dominant frequency components of the reference signals and embeds these in the predictive-repetitive controller. Analysis is undertaken using the frequency response of the closed-loop system. The structure determination of a repetitive controller is considered as a balance between the reduction of tracking errors and minimization of the effect on performance of unwanted elements such as measurement noise and model uncertainty. The implementation of operational constraints on the amplitudes of the control signals, their increments and on the plant outputs is considered based on an on-line solution using quadratic programming via the identification of active constraints. Experimental results from application to a 2-D robotic system are used to illustrate the design and implementation procedures developed.

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, electrical drive control and control technology application to industrial processes. She co-authored a book with Professor Will Cluett entitled *From Process Data to Process Control- Ideas for Process Identification and PID control* (Taylor and Francis, 2000). She co-edited two books with Professor Hugues Garnier, and authored '*Model Predictive Control Design and Implementation using MATLAB®*' published by Springer-Verlag in 2009. She is the lead author of the book entilted 'PID and predictive control of electrical drives and power converters using *using MATLAB®*' published by Wiley-IEEE Press in 2015. Dr Liuping Wang has successfully applied the predictive control technologies to food extruders, automotive brake-by-wire systems, magnetic bearing systems, electrical drives and power converters. 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