Passivity based control and its use in the stability and performance analysis of networked control systems

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Abstract

Passivity based control techniques have gained an increasing popularity during the last decade because of their effectiveness and close relations to physical system modeling. Roughly speaking, passive systems can be shown to dissipate physical (or virtual) energy-like quantities that can be used as Lyapunov-functions for the open or the closed loop system. Passive systems are easy to robustly stabilize and certain (possibly complex) interconnections of passive systems remain passive. In a networked control system (NCS), the classically assumed direct links between sensors, controllers and actuators are completely or partially replaced by separate or shared network channels. The great significance of NCSs is obvious today when more and more areas are being covered with wired or wireless networks. It is well-known that network delays or faults have a substantial effect on the performance or even on the stability of controlled systems. The latest research results show that the currently best estimates for the allowable network delays can be given in the passivity and Lp-gain framework. In this lecture, the basic concepts and methods of passivity based control will be shown. The stability analysis of networked control systems will be illustrated on the example of a pressure stabilizing loop actually implemented in a network environment at a nuclear power plant.

Keywords: Passivity based control, Networked control systems

Presenting Author's Biography

Gabor Szederkenyi is a senior researcher in the Process Control Research Group of the Computer and Automation Research Institute of the Hungarian Academy of Sciences. He received his M.Eng. in Information Technology and his Ph.D. in Information Science from the University of Veszprem, Hungary in 1998 and 2002, respectively. His research interests include the analysis and control of nonlinear dynamical systems and system identification.