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Mean-square stabilizability of networked LTI systems with random channel induced delay

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Abstract:

This talk investigates the mean-square stability and stabilizability of a networked SISO feedback system over a communication channel with random transmission delay and packet dropout. The transmission delay for each data is an integer step within a given bounded range. A sequence of transmission delays for all transmitted data is an independent and identically distributed (i.i.d.) stochastic process and the probability mass function (PMF) for the transmission delays and packet dropout is known. With this delay model, the communication channel is decomposed into two parts: One is a finite impulse response channel determined by the delay/packet dropout' s PMF in mean sense. A nominal closed-loop system is obtained of the networked feedback system, which consists of the plant and controller in the system as well as the channel in mean sense. The other is a stochastic channel uncertainty which is with a random finite impulse response. Each element in the impulse response is with zero mean. It is shown that this stochastic channel uncertainty is a colored multiplicative noise and the networked system is a feedback loop comprised by the nominal closed-loop system and

this noise. The ratio between the spectral density factorization of the multiplicative noise and the transfer function of the channel in mean sense is called a colored signal-to-noise ratio. A necessary and sufficient condition is found for the mean-square stability of the network feedback system with a given controller, which is determined by the H2-norm of the product between the nominal system' s transfer function and the colored signal-to-noise ratio. Moreover, the mean-square stabilizable condition of the networked system is presented and the interaction between the colored signal-to-noise ratio and the plant' s unstable poles is studied in the mean-square stabilization problem. According to the mean-square stabilizable condition, an optimal output feedback controller is designed in the mean-square stabilization for the networked system.

Biography:

Weizhou Su received the B.Eng. and M.Eng. degrees in automatic control engineering from the Southeast University, Nanjing, Jiangsu, China, in 1983 and 1986, respectively, the M.Eng. degree in electrical and electronic engineering from Nanyang Technological University, in 1996, and the PhD. degree in electrical engineering from the University of Newcastle, Newcastle, NSW, Australia, in 2000. From 2000 to 2004, he held research positions in the Department of Electronic and Computer Engineering, Hong Kong University of Science and Technology, Hong Kong, China; the School of QMMS, University of Western Sydney, Sydney, Australia, respectively. In 2004, he joined the School of Automation Science and Engineering, South China University of Technology, Guangzhou, China, where he is currently a full professor. His research interests include networked control system, robust and optimal control, nonlinear systems and control, fundamental performance limitation of feedback control, and signal processing.