ABSTRACT

Traditional controllers require periodic sampled transmission of feedback data and controller inputs resulting in excessive use of bandwidth and computational power for cyber-physical systems. In contrast, in this paper, an event sampled optimal adaptive control of cyber-physical systems, represented as an uncertain linear dynamic system, is presented in the presence of the network induced delay and random packet losses. The system dynamics are reformulated by incorporating the delay and packet loss and a stochastic optimal adaptive controller by using the adaptive dynamic programming and Q-learning technique is designed under the event sampled state vector. Further, the Q-function estimate is adjusted by using a novel event sampled tuning law which in turn saves computation when compared to traditional periodic sampled adaptive control. The estimated parameters and the event sampled state vector are, subsequently, used to design the optimal controller. Furthermore, to decide the aperiodic sampling instants, an event-trigger condition is derived analytically by using Lyapunov stability analysis and, used to demonstrate the asymptotic stability of the closed-loop system. Finally, simulation results are included to substantiate the theoretical claims and show a saving of 63% in bandwidth usage and 58% in computational load.