A state-feedback approach to event-based control

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Event-based control is a means to reduce the communication between the sensors, the controller and the actuators in a control loop by invoking a communication among these components only after an event has indicated that the control error has exceeded a tolerable bound. This working principle differs fundamentally from that of the usual feedback loop, in which the sensor data are communicated to the controller continuously or at every sampling time. Hence, in the control schemes currently used a communication takes place independently of the size of the control error and, in particular, also in case of small control errors when a feedback is not necessary to satisfy the performance requirements. In these situations, the communication and computing resources are used unnecessarily.

The main aim to be reached by event-based feedback is the reduction of the communication among the components of the feedback loop. If the information is transferred to and from the controller by a digital communication network, an overload of this network should be avoided by reducing the information exchange to the minimum communication that is necessary to ensure the required system performance.

This paper describes a new method for event-based state-feedback control in which a control input generator mimics a continuous feedback between two consecutive event times. The performance of the event-based control system is evaluated by comparing this loop with the continuous state-feedback loop. An upper bound of the difference between both loops is derived, which shows that the approximation of the continuous state-feedback loop by the event-based control loop can be made arbitrarily tight by appropriately choosing the threshold parameter of the event generator.

Experimental results show the characteristic behaviour of event-based control loops and the considerable reduction of the communication obtained by this method.

References
