Technische Universität Berlin
Fakultät IV Elektrotechnik und Informatik
Fachgebiet Regelungssysteme
Leitung: Prof. Dr.-Ing. Jörg Raisch
Sekr. EN 11, Tel. 314-22999

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Adolfo Anta

CyPhyLab, Electrical Engineering Department, University of California, Los Angeles, USA
and
Max Planck Institute for Dynamics of Complex Technical Systems, Magdeburg, Germany

“Self-triggered control”

Digital implementations of feedback controllers offer many advantages with respect to analog implementations, such as accuracy or flexibility. A physical system is controlled by measuring its state at discrete time instants, using the measured state to compute a feedback control law, and updating the actuator with the computed law also at discrete instants in time. Under such implementations, one important question is what kind of requirements need to be imposed on these time instants to achieve desired performance. Traditionally, engineers and researchers have opted for conservative strategies, such as periodic sampling of signals and periodic execution of control laws. Periodic implementations execute the controller every T units of time, regardless the state of the control system, unnecessarily consuming the available resources. However, due to the growing complexity of systems, more efficient implementations are required, since resources are usually shared between several subsystems. In this talk we go beyond the periodic model and, drawing inspiration from event-triggered control, we develop self-triggered control laws that decide their next execution time based on the current state of the system. This approach considerably reduces resource utilization while ensuring stability and desired levels of control performance. Several applications, such as real-time scheduling co-design in embedded systems and bandwidth allocation in networked control systems, are discussed to show the benefits and the applicability of the results herein derived.