Proposal for an IFAC World Congress 2017 special track on "Event-triggered and self-triggered control"

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Abstract— **Recent developments in computer and communication technologies are leading to an increasingly networked and wireless world. This raises new challenging questions in the context of networked control and cyber-physical systems, especially when the computation, communication, and energy resources of the system are limited. To efficiently use the available resources, it is desirable to limit the control actions to instances when the system really needs attention. Unfortunately, the classical time-triggered control paradigm is based on performing sensing and actuation actions periodically in time (irrespective of the state of the system) rather than when the system needs attention. Therefore, it is of interest to consider event-triggered control (ETC) and self-triggered control (STC) as alternative paradigms that trigger control actions based on the system state, output, or other available information. ETC and STC can thus be seen as control strategies introducing feedback in the sensing, communication, and actuation processes. To enable the wide exploitation of these aperiodic control concepts in various domains, there is a strong need for both a rigorous system theory and proof-of-concepts of the main ideas in experimental and real-life applications. To support the development of this system theory and stimulate the application of ETC and STC, we propose a special track in the IFAC World Congress that will present recent advances in the area of ETC and STC and their applications.**

I. MOTIVATION AND RELEVANCE

In many control applications nowadays, the controller is implemented on a digital platform. In such an implementation, the control task consists of sampling the outputs of the plant and computing and implementing new actuation signals. Typically, the control task is executed periodically, since this allows the closed-loop system to be analysed and the controller to be designed using the well-developed theory of sampled-data systems, e.g., [1], [2]. Although periodic time-triggered sampling is preferred from an analysis and design point of view, it is sometimes less preferable from a resource point of view. Namely, executing the control task at times when no disturbances are acting on the system and the system is operating desirably is clearly a waste of computational resources. Moreover, in case the measured outputs and/or the actuator signals have to be transmitted

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over a shared (and possibly wireless) network, unnecessary utilisation of the network and power consumption of the wireless radios are introduced. To mitigate the unnecessary waste of computational and computation resources, an alternative to periodic control, namely, event-triggered control [3]–[6] and self-triggered control [7] have been proposed. Event-triggered control (ETC) is a control strategy in which the control task is executed after the occurrence of an external event, generated by some well-designed event-triggering mechanism, rather than the elapse of a certain period of time as in conventional periodic control. Self-triggered control (STC) is proactive as at an event-time the next event-time is precomputed based on current state or output information of the plant. As experimental results show, event-triggered and self-triggered control are capable of reducing the number of control task executions, while retaining a satisfactory closed-loop performance. Although the advantages are well-motivated and practical applications show its potential many questions remain unanswered to date even though progress was made in recent years and the area is receiving an increasing amount of attention in our community. See, e.g., [8] for a recent overview.

II. ACTIVE RESEARCH AREA

ETC and STC are currently popular research topics. This is evidenced by many invited sessions at major control conferences and in 2015 there was even a conference (EBCCSP'15 in Krakow, Poland) dedicated to this topic and uniting the event-triggered control communities with the event-triggered communication and signal processing communities. The proposers of this track have ample experience with organising invited sessions on ETC and STC. For example, they organised them at

- European Control Conference 2009 in Budapest, Hungary
- IEEE Conference on Decision and Control 2010 in Atlanta, USA
- IEEE Conference on Decision and Control 2011 in Orlando, USA
- IEEE Conference on Decision and Control 2012 in Maui, USA
- IEEE Conference on Decision and Control 2013 in Milano, Italy (2)
- IEEE Conference on Decision and Control 2014 in Los Angeles, USA (2)

- IEEE Conference on Decision and Control 2015 in Osaka, Japan (3)

in which each of the sessions were at least attended by 50 people and often more than 100 people were present. Given that the number of invited sessions are growing and the fact that the IFAC World Congress has a significantly larger number of attendees, we expect an even larger number of contributors and attendees to the proposed special track.

III. The special track

Clearly, a system theory in the area of ETC and STC is not complete at present and many questions still require further investigation. In the proposed special track on "Event-triggered and Self-triggered control" we aim for shedding light on the recent advances in the area of ETC and STC. In addition to papers proposing new STC and ETC strategies and/or provide new theoretical results, we also explicitly solicit papers that show the potential of ETC and STC in experimental setups and real-life applications. The presentation of real applications of ETC and STC in the special track should show the real potential of the developed system theory on the one hand, but also identify new research challenges for this flourishing research area.

The special track will be supported by the following IFAC Technical Committees:

1) 1.5 Networked systems (chair: Hideaki Ishii)
2) 1.3 Discrete-event and hybrid systems (chair: Yorai Wardi)

Both chairs and both Technical Committees approve and support this initiative. It is most natural to let the submitted papers to this special track be handled by TC 1.5 (although both technical committees could be involved).

References

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