

IFAC World Congress 2020 - Open Invited Track
**Supervisory Control Theory and Reactive Synthesis
for Cyber Physical System Design**

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Abstract. *Supervisory Control Theory* (SCT) and *Reactive Synthesis* (RS) are two techniques for the automatic design of a digital system from a given specification which are recently applied to *Cyber Physical System* (CPS) design. Both methods mostly evolved independently in two distinct research fields, namely control theory and computer science. It is the main purpose of this invited session to enhance the mutual understanding of benefits and limitations of SCT and RS methods in the context of CPS design and to motivate collaborative efforts within their intersection.

Keywords. Discrete Event and Hybrid Systems, Control Design

Supervisory control theory (SCT) originates in the control community and synthesises a controller that – in closed-loop configuration with a plant – enforces a given specification. In contrast to other branches of control, SCT focuses on systems where all dynamics are driven by discrete events as opposed to continuous signals, as e.g. in manufacturing systems.

Reactive synthesis (RS) originates in computer science and synthesises a computer program such that a prescribed specification is fulfilled. Recently, RS is used for CPS design, mostly in the domain of robotics, where it is commonly referred to as 'formal methods in control'.

While both design methodologies target the same problem class, they have evolved mostly independently. It is the main purpose of this invited track to enhance the mutual understanding of benefits and limitations of SCT and RS methods in the context of CPS design.

In particular, it is known that RS for CPS design has certain drawbacks resulting from the fact that it was not originally developed as a controller synthesis tool. It can therefore benefit from SCT which was designed for this purpose. On the other hand, SCT is known to mostly focus on high-level supervision of existing technical systems. Thereby, SCT is not readily applied to problems where behavior should be *generated* (as in robot motion control) rather than safely *supervised*. As RS is targeted towards behavior generation, there are major benefits when using RS methods within SCT. Finally, it was shown that RS and SCT are very closely related if systems are modelled as non-terminating processes. SCT theory for this system class was developed almost 30 years ago but got very little attention within the SCT community. This open invited track intends to raise awareness of the usefulness of this 'almost forgotten' branch of SCT for CPS design.

Given its outlined scope, we welcome contributions to this open invited track from both the the supervisory control and the reactive synthesis (or formal methods) community, with a particular focus on non-terminating processes and the interaction of behavior generation and supervision. In particular, we encourage contributions that lie in the intersection of both research fields.