Position Paper Abstract: Stability of Cyber-Physical Systems Using Cooperating Invariants *

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ABSTRACT

Cyber-physical systems consist of computational components interconnected by computer networks that monitor and control switched physical entities interconnected by physical infrastructures. Ensuring stability and correctness (both logical and temporal) of a cyber-physical system as a whole is a major challenge in cyber-physical system design. Any incorrectness or instability in one component can impact the same features of other components. The fundamental challenge in developing a design framework that unifies the various components is the heterogeneity of the component types, resulting in semantic gaps that must be bridged. For example, while the physical stability and correctness of aircraft in unmanned aerial vehicle squadrons may be expressed using Lyapunov and Lyapunov-like functions, the notion of correctness in the context of the cyber devices are best expressed in the form of a conjunction of logical operators on system parameters.

In our work, we employ a fundamentally different approach than much existing work; our work composes correctness instead of functionality. The basic idea, depicted in Fig 1, is to express the stability and correctness constraints of all components in the form of logical *invariants* and ensure that system actions are performed only if and when they are guaranteed not to violate the conjunction of these invariants. Recent work has developed invariants for power systems [1] and the concept is amenable to coordinated transportation systems [2].

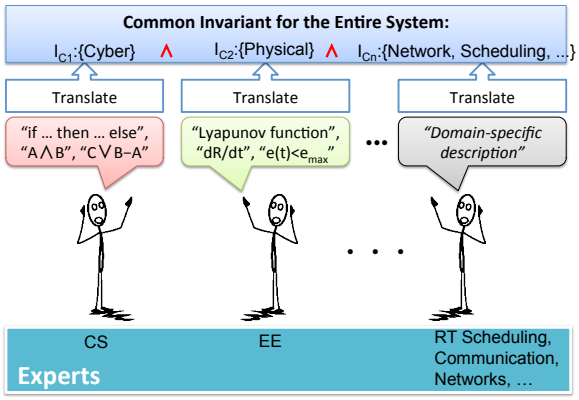

Figure 1: Overview of invariant-based approach

1. REFERENCES

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