

Testbeds in Cyber-Physical Systems: Interfaces and Timescales

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Abstract

Transforming physical systems into mathematical abstractions has a long history of success, but cyber-physical systems invalidate the assumptions that permit many of those abstractions. The development of a physical testbed of a CPS permits testing and system identification for researchers who are interested in specific platforms, but the interfaces through which these testbeds are sampled and controlled vary widely from application to application, even if the platform is the same. This paper discusses fundamental issues of testbed interaction for CPSs with two classes of testbeds: (i) full-sized passenger cars, and (ii) home heating and cooling units. Among the key issues discussed are the timescales over which control inputs execute, and the interaction timescales with humans who are in the loop with the system. The paper includes some discussion of the benefits of code generation and interface testing, in order to prevent catastrophic loss of control or damage to the testbed. Future work includes the extension of these concepts to help bridge the physical and cyber testbeds for societal scale applications such as the smart grid.