CPS: Medium: Collaborative Research: Abstraction of Cyber-Physical Interplays and Its Application to CPS Design

Submitted by C.Mani Krishna on Thu, 04/07/2011 - 6:24pm

Project Details

Lead PI:	C.Mani Krishna
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Performance Period:	10/01/09 - 09/30/14
Institution(s):	University of Massachusetts Amherst
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Abstract: The objective of this research is to develop abstractions by which the controlled process and computation state in a cyber-physical system can both be expressed in a form that is useful for decision-making across real-time task scheduling and control actuation domains. The approach is to quantify the control degradation in terms of response time, thereby tying computer responsiveness to the controlled process performance and use such cost functions to effectively manage computational resources. Similarly, control strategies can be adjusted so as to be responsive to computational state. Unmanned aircraft will be used as vehicles to demonstrate our approach. The intellectual merit of this research is that it takes disparate fields, control and computation, and builds formal abstractions in both the computation-to-control and control-to-computation directions. These abstractions are grounded in terms of physical reality (e.g., time, fuel, energy) and encapsulate in a form comprehensible and meaningful to each domain, the relevant attributes of the other domain. This research is important because cyber-physical systems are playing an increasing role in all walks of life. It will allow design approaches to be systematic and efficient rather than ad hoc. It is based on a large body of our prior work that has begun to successfully bridge the representational and algorithmic gap that separates the control and computer science & engineering communities. Dissemination of results will be by means of courses in our universities, instructional materials, research and tutorial publications and industry collaboration (e.g., General Motors R&D). The plan is to hire minority/female students.

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