Towards Distributed and Parallel Algorithms for Safety-Critical Cyber-Physical System Applications

Dr. Md. Zakirul Alam Bhuiyan
Department of Computer and Information Sciences
Temple University
Philadelphia, PA

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Abstract

A cyber-physical system (CPS) consists of a large number of autonomous computing devices/sensors/actuators communicating with each other and interacting with physical system environments. CPS holds the promise as the next-generation automated and dependable system for various applications. In this talk, I will introduce a class of security- and safety-critical CPS applications that require addressing ‘cyber’ and ‘physical’ concerns in conjunction, including structural health event monitoring, mobile event monitoring, and rescue operation. Devices/sensors in such an application produce a lot of data (acceleration, acoustic, text, image, or video) so called big data. In computing an event information from the big data, centralized or global monitoring algorithms are conventionally assumed, which faces enormous challenges, including real-time decision-making, low detection quality, resource constraints, as well as application specific requirements. Thus, there is an increasing demand for distributed and parallel computing algorithms for data mining and decision-making. I will discuss a set of research issues in the safety-critical CPS applications that require parallel and distributed computing. I will then go into details of a particular issue from them: event detection through big data mining in the CPS. I will present an approach called DPminer to deal with this issue, which attempts to mine data in parallel and distributed manner, provides event information locally, and reduces the overall communication costs in the CPS. In closing, I will show some game-changing research visions in the areas of dependable CPS research.