Control and Decision in the Era of HPC, Big Data and AI

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In our days, control and decision are essential for the complex functionality and operations of systems ranging from those in science and engineering, to the ones in commerce, finance, and those of the society at large. Applications in science and engineering are increasingly large, complex and could be computational or data intensive. In wide range of application domains, advances in control and decision are possible using state-of-the-art algorithms and applications in HPC and AI. For instance, novel algorithms in HPC and AI have been used for control in balancing application performance with the system power consumption using closed loop feedback and self-aware computing, or sustaining application performance while reducing energy consumption. The introduction of autonomic computing (AC) technology has made a step ahead in creating a vision of self-managing systems to address today's concerns of complexity and total cost of ownership while meeting tomorrow's needs for pervasive and ubiquitous computation and communication. Methodologies for planning control actions in AC systems, which in the past were solely based on control theory, are increasingly relying on AI algorithms.

Regarding data, the amount needed by various applications and systems to process is increasingly hard to manage due to its high volume, variety, veracity, velocity, and due to its structured and unstructured nature. This Big Data can be analyzed for insight using state-of-the-art algorithms from AI empowered by HPC, which could lead to better strategic decisions and control. At a different scale, a tremendous increase in the Internet of Things (IoT) devices ($120 billion by next decade) and their attributes can also be seen as data explosion. Distributed IoT-based applications share many control and decision challenges that can be met, among others, with AI algorithms.

In this talk, I will emphasize and discuss various aspects of the roles HPC, Big Data and AI play for advancing the control and decision in computational/data science and engineering applications.