Cyber-Medical Systems

Requirements, Components and Design

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We are continuously witnessing a relentless growth of computing power, storage capacity and communication bandwidth as well as a major trend in biomedical sciences to become more quantitative and amenable to benefit from the support of electronic systems. Moreover, societal and economic needs push us to develop and adopt health-management approaches that are more effective, less expensive and flexible enough to be personalized to individual and community needs.

Within this frame, distributed data acquisition and control systems, i.e., cyber-physical systems, start playing an important role in health care. Examples include, but are not limited to, remote patient monitoring, emergency care as well as routine care. These examples benefit from organized and optimized means to quantify clinical data, handle large data sets as well as controlling and personalizing therapy and drug administration.

Current electronic devices and systems need to grow in various directions to satisfy the quality needs for health care. Current semiconductor products have to incorporate bio-chemical interfaces, such as sensors, to perform data acquisition directly. The experience in electronic semicustom design and in platform-based design can be ported successfully to integrated sensing devices, where modularity and regularity can be key to reducing non-recurrent engineering costs. The fusion of sensing and microelectronic technologies, as well as the ability of volume production of integrated sensing systems that can be personalized in the very back end of the line or after fabrication is an important scientific and commercial goal. Field-programmable sensing arrays can enable inexpensive multi-panel sensing for various medical applications.

Electronic design automation is a key technology to realize cyber-medical systems. Examples of specific EDA tools and methods encompass physical design of integrated sensors and their coupling to electronics, simulation of complex systems with bio-chemical stimuli, synthesis of decision making circuitry based on plurality of inexact inputs, policies design for therapies exploiting on-line data acquisition, and verification of life-critical applications under broadly-varying and unpredictable input conditions.

Overall, cyber-medical systems represent an important and large market opportunity. EDA is a necessary underlying technology to realize the promises of better and less expensive care for everyone.