IEEE Design & Test

Call for Papers

IEEE Design & Test Special Issue on

Cyber-Physical Systems for Medical Applications

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With the deeper integration of computation, communication and control of electronics and software in medical devices, we are faced with new challenges on design and test of systems with the patient-in-the-loop. For biological and medical domains, the operating environment encompasses a rich web of genomic (transcription, translation, splicing), metabolic (anabolic or catabolic reactions), and physiologic (e.g., heart rate variability, blood glucose dynamics, brain activity) processes that exhibit irregular and time dependent behavior that is not amenable to simplified models.

This brings about significant challenges in the modeling, testing, verification and design of medical systems. For instance, from 1990-2000, over 600,000 pacemakers were recalled and over 40% were due to firmware issues. Similar efforts are sustained for developing artificial pancreas that can maintain the blood glucose within safe bounds with minimal interventions throughout daily activities. As patient dynamics are non-linear, often non-deterministic and depend on several environmental, genetic and physiological contexts, there is a need for both formal and functional modeling to better understand interactions with invasive care.

To meet the safety and efficacy requirements including responsiveness, reliable operation, low power and secure delivery of therapy, there is an urgent need for a new science of system design where device-patient interaction modeling and testing are at the core of any optimization. Several such challenges across low-power data acquisition, long-life implantable system design, high throughput tissue-electrode interfaces, wearable flexible electronic substrates, electrical modulation for physiological response, robotic surgery, clinical process modeling and complex analysis of infections are actively pursued across research communities.

IEEE Design and Test of Computers seeks original manuscripts for a special issue on “Cyber-Physical Systems for Medical Applications” scheduled for publication in August/ September 2014.
The topics of interest include, but are not limited to:

- Cyber-physical systems for medical applications – wearable and bio-implantable devices (e.g., pacemaker and cardiac assist devices), artificial organs (e.g., artificial pancreas),

anesthesia and drug dosing control in clinical pharmacology, molecular dynamics analysis for medical diagnosis, smart health and wellbeing.

- Functional and formal modeling of device and physiological process interaction to ensure the safety and efficacy of the closed-loop system.
- Distributed control & sensing: robust, verifiable, fault-tolerant control of uncertain, multi-modal systems; physiologic signal QoS.
- Low-power system design for long-term monitoring and delivery of therapy
- Medical device hardware security, network protocols and attacks
- Embedded, real-time, networked system infrastructures for medical CPS: Architecture, platform, middleware, and resource management issues and innovations related to safety, security, or verifiability
- Certification of medical devices: quantifiable incremental certification of medical device interoperability, role of design tools and COTS, approval of non-deterministic and self-adaptive devices
- Patient modeling & simulation: large scale, high fidelity organ and patient models for digital and analog system design and testing
- Decision support systems: professionals and patients, as well as patient guidance services, which build on multimodal data fusion, data and pattern analysis, and modeling and predictive algorithms of patient health status
- Medical practice-driven models and requirements: user-centric design, management of failures in a clinical environment, modeling of operational scenarios, including medical devices, caregivers, patients

Submission and review procedures

Prospective authors should follow the submission guidelines for IEEE Design & Test. All manuscripts must be submitted electronically to the IEEE Manuscript Central Web site at http://www.manuscriptcentral.com/. Indicate that you are submitting your article to the special issue on "Cyber-Physical Systems for Medical Applications". All papers will undergo the standard IEEE Design & Test review process.

Schedule

- Submission deadline: November 15, 2014
- Notification of final acceptance: April 30, 2015
- Submission of final version: May 29, 2015
- Publication date: September/October 2015

Questions

Please direct questions regarding the special issue to guest editors:
Paul Bogdan (pbogdan@usc.edu) and Rahul Mangharam (rahulm@seas.upenn.edu).