Guest Editorial: Special Issue on Medical Cyber-Physical Systems

Recent years have witnessed breakthroughs in sensing technology, treatments and ways to interact with patients in medical and healthcare applications. Examples include minimally-invasive embedded and bio-compatible devices, deep-brain stimulation, “smart skin,” and artificial retinas. Furthermore, the medical device industry is undergoing a rapid transformation, embracing the potential of embedded software and network connectivity. Yet, despite the tremendous promise, the medical devices are still burdened by complex design, safety assurance, and tendency to operate independently.

Medical Cyber-Physical Systems (MCPS) are safety-critical, interconnected, intelligent systems of medical devices. The combination of embedded software controlling the devices, networking capabilities, unique sensing and actuation technologies, and complicated physical dynamics exhibited by patient bodies highlights some of the specific research challenges for this distinct class of cyber-physical systems. As such systems become increasingly complex, interconnected, and interoperating, the major challenge is to ensure and improve their safety, security, efficiency and reliability. This special issue describes significant research contributions in this domain, with each article providing contributions to MCPS applications and systems in practice.

The special issue consists of 6 high-quality research articles selected from 26 submissions that had covered a broad range of topics. The article “[A Limb Tracking Platform for Tele-Rehabilitation](#)” introduces a platform to enhance limb functional recovery through telerehabilitation sessions—for such applications, system design poses interesting cyber-physical challenges, for instance, when taking body kinematics into account to improve the precision of measurements, simplify the calibration procedure, or generate bio-feedback signals. A new mobile system for neuro-cognitive function monitoring and treatment is presented in the article entitled “[A Mobile Health System for Neurocognitive Impairment Evaluation Based on P300 Detection](#)”; the presented system architecture features sensors that measure brain potential in real-time, localized data analysis and filtering, and in-cloud distribution to specialized medical personnel. Improving management of operating rooms in hospitals is focus of the article entitled “[A Cyber-Physical System to Improve the Management of a Large Suite of Operating Rooms](#)”. Ensuring safety of MCPS presents a significant research challenge. Articles entitled “[Towards the Emulation of the Cardiac Conduction System for Pacemaker Validation](#)” and “[Closed-Loop Quantitative Verification of Rate-Adaptive Pacemakers](#)” present modeling and analysis techniques to provide strong safety and performance guarantees for implantable cardiac devices. Finally, the article entitled “[Formal Verification of Medical CPS: A Laser Incision Case Study](#)” focuses on the use of formal methods to ensure safety of widely used safety-critical system.

Last but not least, we would like to thank all authors that have contributed to this special issue on their efforts to produce excellent research contributions. This special issue is result of the outstanding effort by the number of reviewers covering areas from computer science and engineering, to medicine, whose thorough reviews and significant efforts have even further improved

the quality of the articles. A special thanks is due to Editor-in-Chief Tei-Wei Kuo and his editorial team for their guidance and support.

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