Computational Modeling of Behaviors from Mobile Measurement of Physiology – Potential, Progress, and Prospects

Abstract

Recent advances in the sensing and computational capacity of mobile devices have opened up enormous opportunities to improve patients’ health and well-being. They can quantify dynamic changes in an individual’s health state as well as key physical, biological, behavioral, social, and environmental factors that contribute to health and disease risk, anytime and anywhere. Such real-time monitoring can accelerate health research and optimize care delivery, e.g., via just-in-time personalized interventions.

In this talk, I will first describe analysis of data yield in a four-week mobile health user study with AutoSense sensor suite among twenty illicit drug users at NIDA Intramural Research Program. We obtained 10+ hours of data yield per day in this study, which demonstrates the feasibility of obtaining good quality physiological data in the mobile environment. To further improve data yield, we identify several factors (both adherence and technology) that still cause data loss. Next, we develop a computation model to identify the physiological response to cocaine usage so as to identify this event in the stream of sensor data. Such a model should be able to detect cocaine use despite diversity in the administration modality (e.g., injection, sniffing, oral, etc.) and variation in dosage amounts. Further, the model should not only distinguish the physiological response to cocaine use from that due to physical activity, but also disentangle their effects, as cocaine use episodes in the field are usually intermixed with physical activity. I will describe our approach to time-series modeling of cocaine use from ECG measurements that is informed by models of sympathetic and parasympathetic nervous system operation, models of cocaine absorption, and stock tracking in financial markets. Finally, I will conclude the talk by describing a research agenda for realizing the vision of just-in-time mobile health interventions.

Biography

Santosh Kumar is an Associate Professor of Computer Science at the University of Memphis. He received his Ph.D. in Computer Science and Engineering from the Ohio State University in 2006. In 2010, the Popular Science magazine named him one of America’s ten most brilliant scientists under the age of 38 (called “Brilliant Ten”). In 2011, he chaired the “mHealth Evidence” meeting jointly organized by NIH, NSF, Robert Wood Johnson Foundation, and McKesson Foundation to establish evidence requirements for mobile health systems. He co-organizes and serves as a core faculty at the NIH mHealth Summer Institutes. In 2013, he was invited to meet with the NIH Director to advise him on NIH efforts in the area of mobile health. He was recently invited to give a talk at the White House on the future of Biosensors.