Foreword

Recent years have seen explosive growth in computing and communications. Just in the last two decades, internet and mobile phones have had great impact on all aspects of our lives at home and work: email, social networks, e-commerce, entertainment, transportation, to name just a few aspects.

Increasingly, our physical surroundings and systems are getting infused with computing and communications. For example, a modern automobile contains several computer networks and processors. And, smart meters are being deployed in our homes and workplaces to make our electric energy consumption and management more efficient. Aircraft engines are being fitted with sensors, computing and communications devices that are transmitting data on the state of the engine for proactive and efficient maintenance. Internet-of-things, or the industrial internet, offers powerful and compelling visions of the rapid evolution of this cyber-physical reality.

It is likely that within the next decade, this infusion of sensors, communications, computing and control into our physical systems and surroundings will have the same transformative impact that internet and mobile phones have had in the last two decades.

Will this transformation benefit humans in the pursuit of more satisfying, happier, and productive lives?

A positive answer to this question is at the center of our vision of future of cyber-physical-social systems. This is particularly important in view of the contemporary commentary in mainstream discussions leading to fears of job losses, privacy, and security. We must make all possible efforts to avoid these dystopian visions and achieve much more positive outcomes in the coming decades.

The essential idea is that human behavior, as individuals and as members of various groups, should be at the center of our thinking in the design and development of internet-of-things and cyber-physical systems. Deep understandings from the fields of psychology, sociology, economics, and anthropology should be combined with cyber-physical systems analysis and

design frameworks and tools for the creation of the future cyber-physical-social systems.

The potential for benefits is, indeed, very great. One of the major concerns at the current time is the significant slowdown in total factor productivity, particularly in the developed nations. One can imagine a future where well-designed cyber-physical-social systems will make our work lives more satisfying and safer while increasing productivity and quality. Imagine how our education processes might become more personalized, effective, and efficient by the deployment of cyber-physical-social education systems that leverage the deep understandings from science of learning and powerful technologies in the classrooms and home while also make the work of teachers more satisfying and productive. Can cyber-physical-social medical systems in hospitals and at home help us lead healthier lives, reduce healthcare cost burdens while also make the work of health care workers more satisfying and productive?

Can we make our transportation systems more efficient, resilient, safer, and sustainable by the development of suitable cyber-physical-social automobiles, trains, airplanes, and systems management and operations? Can the demanding work in mining and construction become safer and more productive by the development of appropriate cyber-physical-social devices and systems?

To realize these promising and attractive futures will require engineers, physical scientists, bio-medical scientists, computer scientists and social-behavioral scientists to deeply integrate knowledge, tools, techniques, and modes of thinking to create new ways of conceiving, designing and implementing future cyber-physical-social systems. This, however, is far from easy. The challenge lies in the academic disciplinary traditions and separations that make such integration very difficult.

I am delighted that work along this line has started to appear. This volume is an example of such an amalgam of ideas from different fields pertaining to the cyber-physical-social aspects of electric power systems engineering. The co-editors of this book, who are actively engaged in this area of emerging research, have organized the chapters in sections apropos to the ongoing modernization of the electricity infrastructure, namely, stability and security; controls and economics in the end-user realm; social aspects; and, testbeds for validation. The contributing authors are experts in their field and bring a wealth of knowledge to this book via their contributions.

It is often stated that we live in a time of accelerating technological change. Indeed, the rates of internet and smartphone technologies pene-

tration are remarkable by all historical standards. Therefore, we might anticipate rapid development and penetration of internet-of-things and design and development of cyber-physical-social systems. Indeed, as Bill Gates has observed, "We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten. Don't let yourself be lulled into inaction." I am confident that the research community, far from being lulled into inaction, will seize this incredible opportunity to improve the human condition.

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