The 2nd IFAC Conference on Cyber-Physical & Human Systems

By the CPHS Operating Committee

The 2nd IFAC Conference on Cyber-Physical & Human Systems (CPHS) took place on December 14-15, 2018 at the Hyatt Regency in Miami, Florida, USA.

Steady advances in controls, communications and computing have enabled new forms of interactions between cyber-physical systems (CPS) and humans, either as operators, agents, subsystems, or end users. These Cyber-Physical & Human Systems (CPHS) are simultaneously redefining the role and position of humans in broad areas of application, blurring the traditional boundaries between humans and technology. CPHS is a newly established conference series, focused on gaining a deeper understanding of these varied interactions, bringing together researchers and practitioners from academia and industry to share scientific and technological advances, and examining the underlying multidisciplinary dimensions from the perspectives of engineering, human-factors, and the social sciences. Of particular focus are human-centered technologies in a wide-range of applications including transportation, energy, robotics, manufacturing, and healthcare.

The inaugural event of the IFAC CPHS conference series was held in December 2016 in Florianopolis, Brazil. As we go forward, the plan is to make this conference series biennial.

CPHS 2018 was sponsored by the International Federation of Automatic Control (IFAC), financially sponsored by the American Automatic Control Council (AACC), and technically co-sponsored by the IEEE Control Systems Society (CSS). A panel session on the interface between engineers and social scientists received funding from the IEEE CSS Outreach Fund, and a mini-workshop on cross-disciplinary communication and collaboration in CPHS research was funded in part by the Ford Motor Company and the European Embedded Control Institute.

There were 107 submissions received, from which 81 were selected for presentation at the conference, which corresponds to a 76% acceptance rate. There were 2 parallel tracks of oral sessions on each day as well as a poster session. The program highlights included two plenary lectures:
- David Woods (Ohio State University), “Adaptation and complexity in layered networks: How new technological capabilities are hijacked by people seeking advantage”
- Ruzena Bajcsy (UC Berkeley), “Robotics is a System Science: Educational Implications”.

The total number of registrations at CPHS 2018 was 141, which included 34 students. One of the reasons for this healthy registration number could be its colocation with the 57th IEEE Conference on Decision and Control which immediately followed this conference. The countries with the highest number of registrations were the United States (80), France (18), Germany (13), and Japan (13).

A total of three special sessions formed part of the conference program. The first of these was organized on Thursday, December 13, 2018, in parallel with the opening reception, with its focus on research demonstrations, using both software and hardware. A total of nine demos were presented, ranging from the use of a human wearable device for controlling robotic swarms to interactive software games aimed at understanding how people invest in security. The second special session was held on Friday, December 14, 2018 immediately after the conference banquet, which consisted of an interdisciplinary panel on the "Interface between Engineers and Social Scientists: Low-Hanging Fruit, Language Barriers, and Synergy". The panelists Jerome Busemeyer from the Department of Psychological & Brain Sciences at Indiana University - Bloomington (U.S), Frédéric Dehais, head of neuroergonomics and human factors at the Institut Supérieur de l'Aéronautique et de l'Espace (France), Pramod Khargonekar from the University of California, Irvine, and A. Michael Froomkin from the University of Miami Law School, covered the areas of computational modeling of human decision making, neuroergonomics, human factors, risk-, trust- and legal aspects of autonomous transportation technologies, as well as the engineering side of cyber-physical systems. The panel addressed the following questions: a) What are the major cognitive science principles for the design of (semi-)autonomous CPS? b) How can the design of cyber-physical infrastructure systems be optimized for desired societal outcomes? c) What are the key factors that enable cyber-physical systems to augment human performance? d) How can we integrate lessons from anthropology into the design of cyber-physical systems for their productive assimilation into communities and society?

Jerome Busemeyer talked about new fields which are at the intersection with cognitive science, including dynamic decision-making models for humans interacting with automation, and how non-commutative probability theories may be useful for describing and analyzing these behaviors. He pointed out that a better understanding of the functionality of deep neural networks may be relevant. Pramod Khargonekar highlighted how cyber-physical and human systems are systems of systems, with multiple levels of feedback and control. He pointed out that while humans design and create these systems, they also interact with and use them, and that much research remains to be done on modeling, analysis and design in these domains. Frédéric Dehais discussed how existing automation designs often omits a serious consideration of the human behavior, and the interplay between the two agents in critical situations can lead to unexpected (and undesirable) results. Michael Froomkin highlighted how regulation and laws are important for new CPHS, and must be taken into account when designing and deploying these new technologies. Engineering and social science research results should also help inform laws and regulations.

The third special session consisted of a mini-workshop titled Cross-disciplinary Communication and Collaboration in CPHS Research which sought to highlight strategies for successful collaboration across disciplines and identify critical cross-disciplinary research questions. It began with a presentation by Robert Gregg (University of Texas at Dallas) highlighting his experience collaborating with clinicians on his research in control mechanisms of human locomotion with applications to wearable and autonomous robots. He emphasized the importance of the time he spent as a research

scientist at the Rehabilitation Institute of Chicago in his ability to collaborate across disciplines. He was followed by Ruzena Bajscy (UC Berkeley) who shared lessons from her long and successful career filled with collaborations outside of her core discipline. The workshop also included a panel discussion consisting of IEEE CSS Technical Committee chairs and members relevant to cyber-physical and human systems: Yue (Sophie) Wang (Chair, TC on Manufacturing Automation and Robotic Control), Richard Hull (Chair, TC on Aerospace Controls), Jason Siegel (Chair, TC on Automotive Controls), and Cedric Langbort (TC on Smart Cities). Each panel member described how their TC is directly connected to cyber-physical-human systems research and also reflected on lessons they learned in engaging researchers of other disciplines.