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Cyber-physical innovations:: Cyber-infrastructure for research, cyber-physical architecture for real-time applications, autonomous vehicle (AV) governance and AI artifacts for public value

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ABSTRACT

This panel explores the development of innovative, integrative, and versatile strategies to facilitate more practical and effective use of intelligent cyber-physical technologies from a variety of perspectives, including engineering, regulation, management, and research. With the same goal of sustaining the development of emerging technologies to best benefit our communities, this panel shares their different approaches in terms of engineering solutions for real-time controlling in cyber-physical systems, regulatory strategies to overcome the conflict between efficiency and autonomy, artifacts for artificial intelligence project management, and meeting researcher needs through large-scale cyberinfrastructure. The selected cases discussed in this panel not only highlight the critical challenges in implementing cyber-physical technologies into real applications but also suggest promising strategies to overcome those issues from diverse facets.

CCS CONCEPTS

• **Cyber-physical systems**; • **Cyberinfrastructure**;

KEYWORDS

Cyberinfrastructure

*anel Moderator

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1 PANEL OBJECTIVE

Cyber-physical system is one of the most prominent features of smart cities, intelligent governance, and modern community development that seamlessly connects a variety of physical components for more efficient and sustainable operations of society. While emerging cyber-physical innovations provide tremendous opportunities to improve the development of modern communities and the convenience of social life, challenges come together with those opportunities from different aspects. This panel discusses the challenges and research progress of solutions to better develop and integrate intelligent cyber-physical technologies into modern society from distinctive perspectives, including engineering, regulation, management, and research. A diversity of insights will be shared by the panel to present the audience with informative resources regarding the state of the art of academic progress on the research topic of cyber-physical systems.

2 FEATURED TOPICS

2.1 The development of a cyber-physical systems architecture for real-time applications by Pei-Chi Huang, Xin Zhong

This study, led by Drs. Huang and Zhong, investigates the integration of computation, networking communication and the control of physical processes to develop autonomous, intelligent, responsive, and collaborative products. As the proliferation of the Internet of Things (IoT) connected devices reach over 200 billion, cyber-physical systems (CPSs) design methodology in IoT becomes increasingly complex, dealing with critical and pertinent tasks. In the real world, the significant information from these devices in CPSs can be collected and actions are taken to control processes and then enhance human efficiency and productivity. Applying visual sensors like camera sensors as a feedback source for control becomes a real-time, robust, and effective solution for CPSs design in IoT, where computer vision techniques play an important role. However, these sensors, complex processes, changing context and uncertainties in the environment without any human involvement often led to system crashes, deterioration, and may even produce personal injury and property damage. Therefore, it is a remaining challenge to raise the abstraction level from hand-design or modeling-based programming towards higher-level temporal logic specifications or a controlled natural language which includes artificial intelligence techniques and controller synthesis to learn the executable tools that exhibit the desired real-time system behavior.

2.2 Values for AV Governance – How to overcome the conflict between efficiency and autonomy? by Johannes Himmerlreich

Many legislators are preparing to regulate AVs in key issues of safety, liability and ethics. This paper addresses the central ethical question in AV technology that touches on each of these topics: Who should decide how AVs drive? The paper makes two contributions. First, the paper identifies a conflict between efficiency and autonomy. Second, the paper develops a policy option that illustrates how this conflict can be overcome in a way that improves on existing alternatives.

AVs need to make several value-based choices. The most salient of which concerns collision management: If an AV has to choose between causing identical injuries to either a passenger or to a pedestrian, what should the car do? Dilemma situations like this are known in philosophy as the trolley problem. Beyond such tragic dilemma situations, many mundane decisions that AVs face present similar trade-offs between the interests of different parties.

To regulate such situations, policymakers need to decide who should decide how AVs behave in traffic. One option is that passengers decide on the main parameters of an AV's driving behavior. Alternatively, the parameters of vehicle behavior could instead be specified by law. The first option is known as personal ethics settings (PES) the second is mandatory ethics settings (MES). The existing literature has argued for each option. This presentation reviews these arguments and places them in a framework: The arguments constitute a conflict between efficiency and autonomy. The paper argues that this conflict can be overcome and provides an example of how it can be overcome.

2.3 Two Artefacts for Managing Cognitive Computing Projects in the Public Sector: Business Model Canvas and Maturity Model by Kevin Desouza

Artificial Intelligence (AI) systems are deployed across the public sector. Yet, most organizations have limited artifacts that can be used to manage these efforts. Employing a design science research approach, this presentation will suggest two artifacts that were created to support public agencies in their AI projects. The first is a business model canvas that can be used to capture create, and communicate how AI projects contribute public value. The second is a maturity model that can be used to gauge an agency's capabilities with cognitive computing systems. Both artifacts were created employing a design science research methodology.

2.4 Meeting researcher needs with large-scale distributed cyberinfrastructure by Richard Knepper

As existing computational disciplines begin to use larger models for their analyses, new fields are adopting computational methodologies, and science domains across the spectrum from humanities to medicine to astronomy are incorporating artificial intelligence into their research, the demand for computational resources at scale continues to grow past the capacity represented by individual resources. A number of initiatives seek to knit distributed cluster and cloud systems together in order to further the aggregate resources available to scientists and lower barriers to entry for early-career researchers and those at under-resourced institutions. These initiatives not only require a complex technical implementation, but they involve interoperation between multiple cooperating institutions. I will describe the range of forms of coordination of these organizations from largely distributed networks to multi-partner cooperatives to hierarchical arrangements, with some commentary on the impacts to service delivery and sustainability of operations over time.

Table 1: Panel Organization.

Topic	Time	Speaker
Introduction to Panel Theme	10 min.	Panel Chair
Case Presentation	50 min.	Panelists
Questions and Discussion	15 min.	Moderator

3 PANEL ORGANIZATION AND PANELISTS BIO

3.1 Panel Organization

The 75-minute panel will be structured in the following manner. The panel chair will introduce the overall theme and objective of the panel presentations and each presenter will have approximately 15 minutes to present their cases. Moderator will facilitate a question and discussion session for the remaining 15 minutes. Dr. Victor Huang will serve as the panel chair and Dr. Michael Ahn will serve as the panel moderator of the panel (see Table 1).

3.2 Panelist Bio

Dependent Chenyu 'Victor' Huang (Panel Chair) is an Assistant Professor in the Aviation Institute at University of Nebraska Omaha. He has a bachelor's degree in Electrical Engineering, a Master's Degree in Air Transportation Planning and Management and Aerospace and Aviation Management, and Ph.D. focusing on Aviation Technology from Purdue University. Dr. Huang has an ATC background and has a history of conducting aviation and aerospace-related research activities partnering with research institutions, the aviation and aerospace industry, and the government. His research interests are in the areas of Unmanned Aircraft System (UAS) operations, statistical modeling of transportation operations, and solutions to flight safety enhancement.

Johannes Himmelreich (Panelist) is an Assistant Professor in the Maxwell School of Citizenship and Public Affairs at Syracuse University and a Senior Research Associate in the Campbell Public Affairs Institute. His work is on applied ethics, political philosophy, and public policy with a research concentration on the ethics of autonomous systems. He published papers on "Responsibility for Killer Robots," the trolley problem and the ethics of self-driving cars, as well as on the role of embodiment in virtual reality. Himmelreich has also published on the commodification of asylum-provision services as well as on the foundations and nature of moral responsibility and blame. He holds a Ph.D. in Philosophy from the London School of Economics (LSE).

Kevin Desouza (Panelist) is a Professor of Business, Technology and Strategy in the School of Management at the QUT Business School at the Queensland University of Technology. He is a Nonresident Senior Fellow in the Governance Studies Program at the Brookings Institution. Desouza has authored, co-authored, and/or edited nine books. He has published more than 140 articles in journals across a range of disciplines including information systems, information science, public administration, political science, technology management, and urban affairs. Desouza has received over $2 USD million in research funding from both private and government organizations. For more information, please visit http://www.kevindesouza.net.

Michael J. Ahn (Moderator), Ph.D., is an Associate Professor and MPA Graduate Program Director at the University of Massachusetts Boston. Michael's research explores various technological innovations in government such as e-government, Smart Cities, and Artificial Intelligence in the public sector and identifies organizational and institutional factors that facilitate impactful IT innovations in government. Michael's articles have appeared on journals such as Public Administration Review, American Review of Public Administration, and Government Information Quarterly, and his op-ed appeared at Brookings Institution and the Conversation.

Pei-Chi Huang (Panelist) received a Ph.D. degree in the Department of Computer Science from the University of Texas at Austin. She is currently an assistant professor with the Robotics, Networking, Artificial intelligence (R. N. A.) Laboratory, in the Department of Computer Science, University of Nebraska Omaha. Her research interests include cyber-physical systems with machine learning, real-time computing and scheduling algorithm, and wireless communication/networking systems, and robotics platforms development.

Richard Knepper (Panelist), Ph.D. is the Deputy Director of the Cornell University Center for Advanced Computing, where he facilitates computational research on cloud, cluster, and supercomputer resources. His research interests focus on science policy, research cyberinfrastructure, virtual organizations, and allocation and usage of computational resources. He is the manager for Cyberinfrastructure Resource Integration in the NSF Extreme Science and Engineering Discovery Environment (XSEDE), where his role is to expand the national aggregate computational infrastructure by helping institutions implementing their own cyberinfrastructure.

Xin Zhong (Panelist) is an Assistant Professor in the Department of Computer Science, University of Nebraska Omaha. His research interests include digital image processing and analysis, computer vision, pattern recognition, computational intelligence, machine learning, deep learning, and image watermarking. He has been working on different artificial intelligence algorithms to identify different patterns in various images and videos. One of his long-term goals is creating computer vision and machine learning technologies to help with extended applications in different areas, such as public service, security, and cyber-physical systems.