

Summary of the Panel Discussion on Cyber Physical Systems: Definition, Research Trends and Key Sources

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Subject Matter

The panel prepared the following headlines for the discussion:

- Defining CPS,
- Relating CPS to other terms such as Internet of Things, Systems of Systems, and Embedded Systems,
- Key knowledge areas within CPS
- Key resources (including seminal papers and books)
- Significant Research areas

- Defining smart cities,
- Societal benefits of smart cities,
- Contributing technologies, CPS in smart cities,
- Smart infrastructures

However, due to the active engagement of the audience and the magnitude of questions from the public, we only managed to treat about half of the prepared headlines.

Definition

Cyber Physical Systems are the result of integration of the following aspects of systems:

- Dynamics and control,
- Computation, and
- Networking and distribution.

Often this is completed with a body of knowledge from the domain (such as transport, automotive, infrastructure or healthcare).

Computational aspects often involve discrete steps, usually described in terms of an algorithm. The control aspects are usually described in terms of differential equations. Hybrid systems are models of CPS that combine these aspects.

This is a very rich area for interdisciplinary collaboration among different scientists with different backgrounds and integration of different bodies of knowledge is a key aspect of CPS design.

Some Significant Research Directions

Data-driven methods for CPS design (based on machine learning techniques)

Model-based methods for CPS design (based on formal methods and control theory)

Compositional analysis

Social and human-related issues of CPS design (including issues such as usability and privacy, e.g., in the healthcare domain)

Legal and jurisprudential aspects of autonomous systems

Some Key Resources

(Text)Books:

[E. Lee and S. Seshia, Introduction to Embedded Systems - A Cyber-Physical Systems Approach](#)

[R. Alur. Principles of Cyber Physical Systems, MIT Press, 2015.](#)

Website:

[NSF's Virtual Organization for Cyber Physical Systems](#)

Key (Overview) Papers:

[E. Lee, Cyber-Physical Systems - Are Computing Foundations Adequate?, NSF Workshop on CPS, 2006.](#)

[R. Baheti and H. Gill, Cyber Physical Systems, The Impact of Control Technology, 2011.](#)

[E. Lee, Cyber Physical Systems: Design Challenges, Proc. of ISORCS'08, IEEE, 2008.](#)

[W. Wolf, Cyber Physical Systems, IEEE Computer, 2009.](#)