

# Panel 3: Innovations in CPS Education

Insup Lee

*PRECISE Center*

Department Computer and Information Science

University of Pennsylvania

[www.cis.upenn.edu/~lee](http://www.cis.upenn.edu/~lee)



# CPS Education Needs

- Training workforce of the future
  - Curricula need to address the systemic challenge of CPS
  - More dynamic training to keep up with the pace of new technology
- Multidisciplinary curriculum
  - Discrete and continuous mathematics
  - Formal methods and feedback control
  - High-assurance software development
  - Communication, concurrency, interaction, and compositionality
  - Application-driven hands-on projects

# CIS 541: Embedded and CPS

- Project: Pacemaker challenge (Boston Scientific), pacemaker board (McMaster)
- Requirements, Modeling, and Analysis
  - Assurance/safety cases (SEI)<sup>2</sup>
  - Formal modeling and analysis (Uppsala)
  - AADL
  - ...
- Implementation Paradigms and Techniques
  - Programming languages (Waterloo)
  - RT Scheduling (UIUC)
  - Feedback in Computer Systems (UVA, Wash U.)
  - Compositionality
  - ...
- Validation, Verification and Certification
  - Mental models
  - Runtime verification
  - ...

# CPS Education Consortium

- Develop and share courseware modules on various topics
  - E.g., Assurance/safety cases
  - Formal modeling and analysis
    - timed automata, process algebra, software model checking
  - RT scheduling, RTOS, virtualization
  - Security and Privacy
  - Trust management
  - ...
- Develop and share application specific artifacts
  - Medical Device CPS
  - ....

# Medical Device CPS

- Support for the design, implementation, and certification of **open** medical technologies
  - Open medical-device requirements/artifacts
    - Examples: pacemaker challenge (Boston Scientific/McMaster/Minnesota), generic infusion pump (FDA/UPenn)
  - Methods and tools
  - Models, analysis and implementation (reusable) artifacts
    - Patients, medical devices, caregivers, ...
    - Specifications and properties
    - Claims, evidences, and arguments
    - Medical devices, virtual medical devices
  - Open testbeds
    - Infusion pumps
    - MD PnP (Medical Device Plug-and-Play)
    - Homecare/assistive living

Thank You!