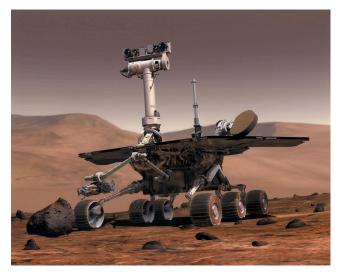# Foundations of Cyber-Physical Systems

Cyber-physical systems (CPS) are mainly computational systems based on discrete logic that are integrated with continuous physical processes with dynamic evolutions. Nowadays, CPS constitutes a lot of critical infrastructures whose functionalities are critical to the core societal functionalities. As cases in point, a precursor generation of CPS systems can be found in areas as diverse as robotics, power grid, healthcare and medical devices, aerospace, automotive, chemical processes, civil infrastructures, transportation, and manufacturing.

The course will introduce students to the modeling, design and implementation, and analysis of CPS safety-critical infrastructures, and their safety/security requirements in real-world settings. It will provide an excellent foundation for students who seek interests in academia/research as well as industry.

In particular, the course will cover:

- ***Modeling Dynamic Behaviors***
    - Continuous system dynamics
    - Discrete dynamics and stochastic state machines
    - Hybrid systems and automata

- ***Cyber-Physical Design and Implementations***
    - Sensors and actuators
    - Memory architecture, IO, multitasking and scheduling
    - Background on power grid infrastructures
    - Programmable logic controllers and control automation

- ***Analysis of Cyber-Physical infrastructures***
    - Controller code binary analysis
    - Stability of linear systems and Lyapunov functions
    - Linear temporal logic and CPS formal verification

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