CPS: Breakthrough: An Entropy Framework for Communications and Dynamics Interdependency in Cyber Physical Systems: Analysis, Design and Implementation

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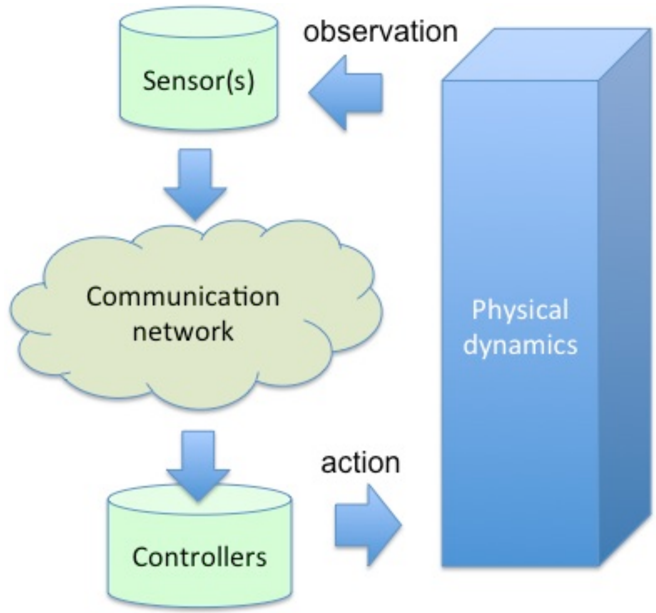
Description

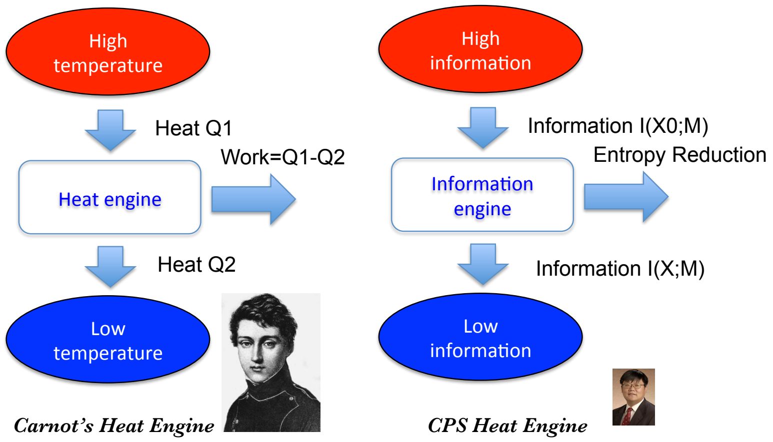
- In CPS, communications are needed for the feedback control in order to stabilize or optimize the physical dynamics.
- A fundamental question: how much communications are needed?



- We propose to bridge communications and control using entropy. The goal of communications is to provide `negative entropy' to compensate the entropy increase in the physical dynamics due to random perturbations.

Findings

Finding 1: Not all communicated bits can be used to compensate the entropy increase in physical dynamics, which is similar to the Carnot engine.



Finding 2: Entropy can propagate in the network of physical dynamics nodes (e.g., power grid), which can be described by partial differential equation (PDF).

First order dynamics: Diffusion of entropy

Second order dynamics: Wave of entropy

Implementations:

- A millimeter wave testbed
- Wireless comm. over UAV
- Millimeter wave through UAV blades