

Seventh Annual Cyber-Physical Systems Principal Investigators' Meeting

Progress and Expectation

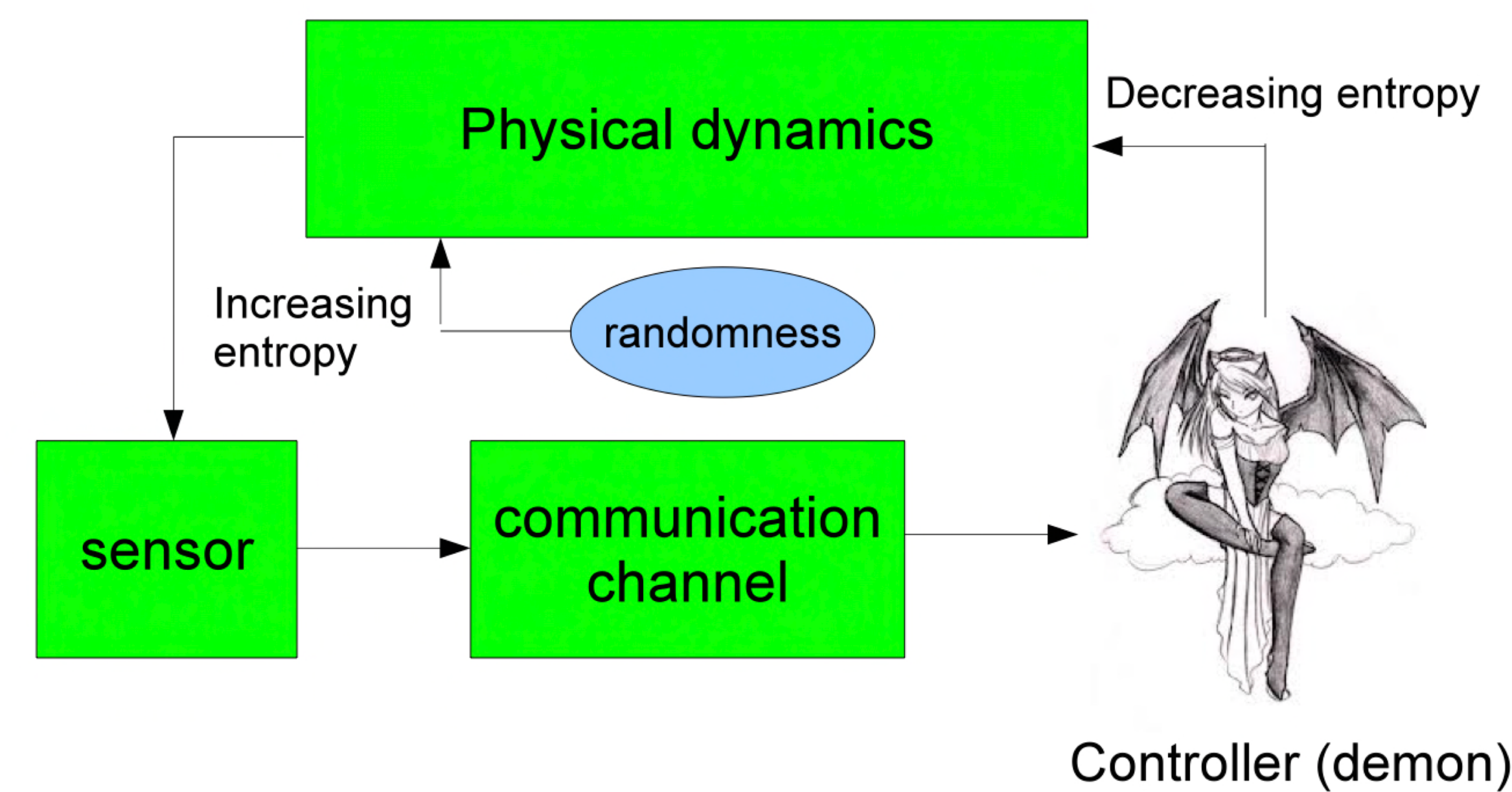
NSF-1543830 CPS: Breakthrough: An Entropy Framework for Communications and Dynamics Interdependency in Cyber Physical Systems: Analysis, Design and Implementation (2015-2018)

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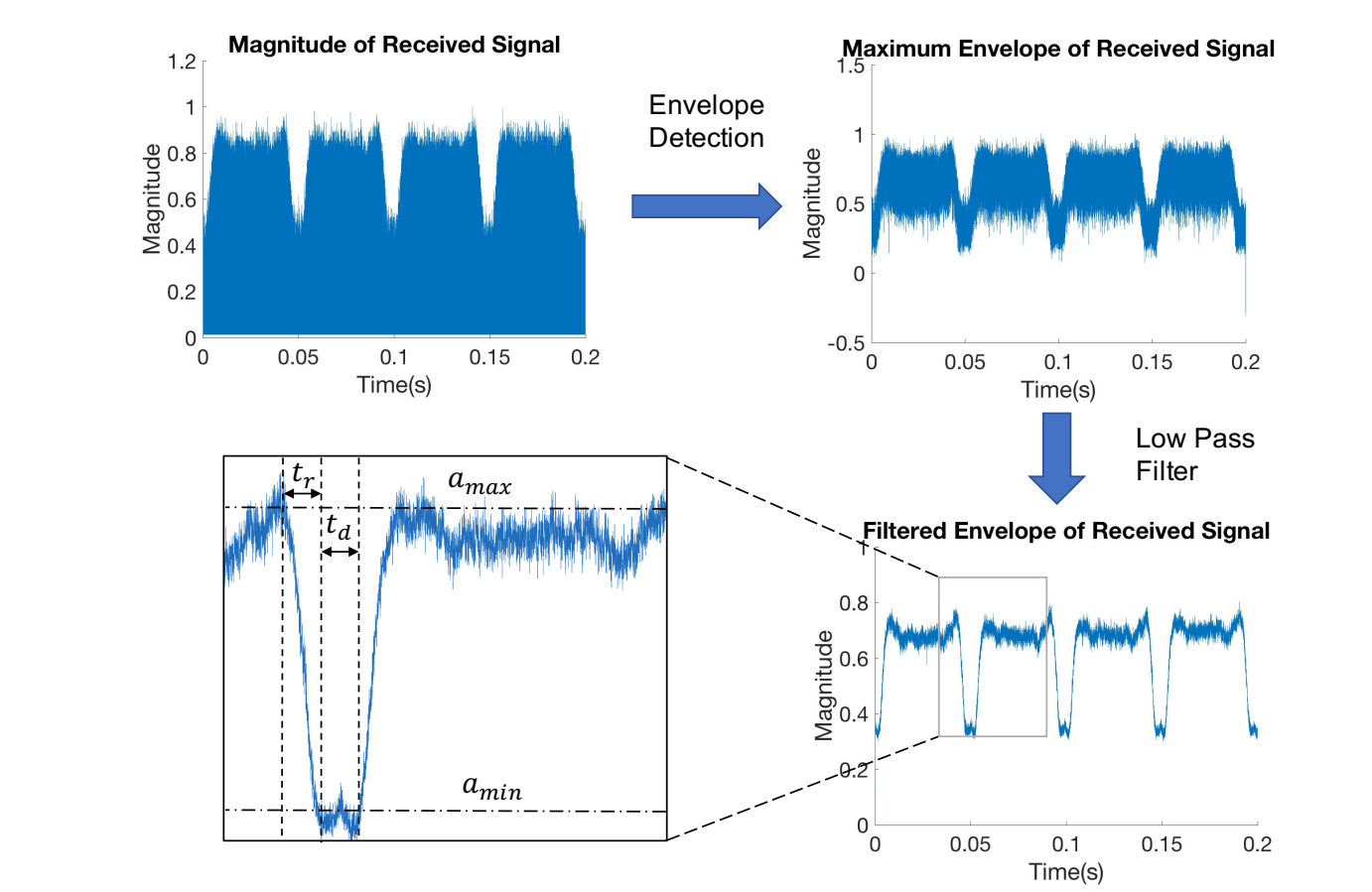
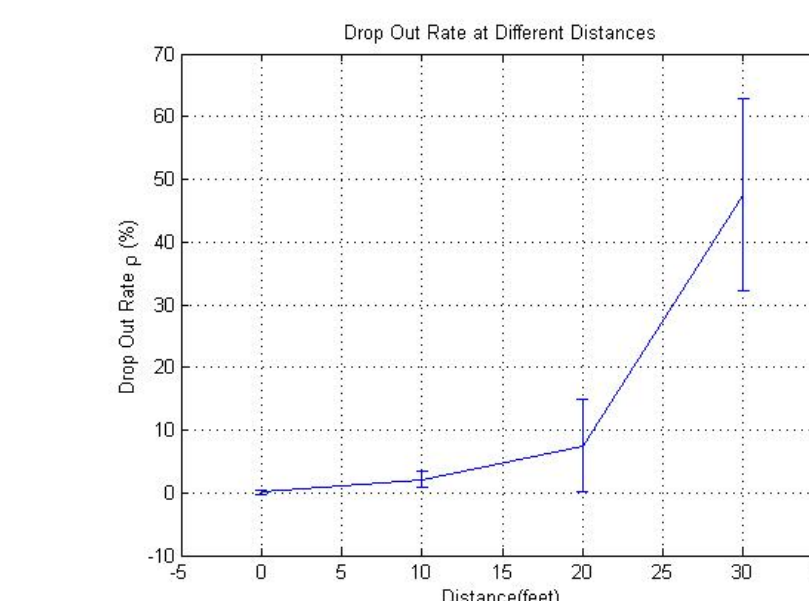
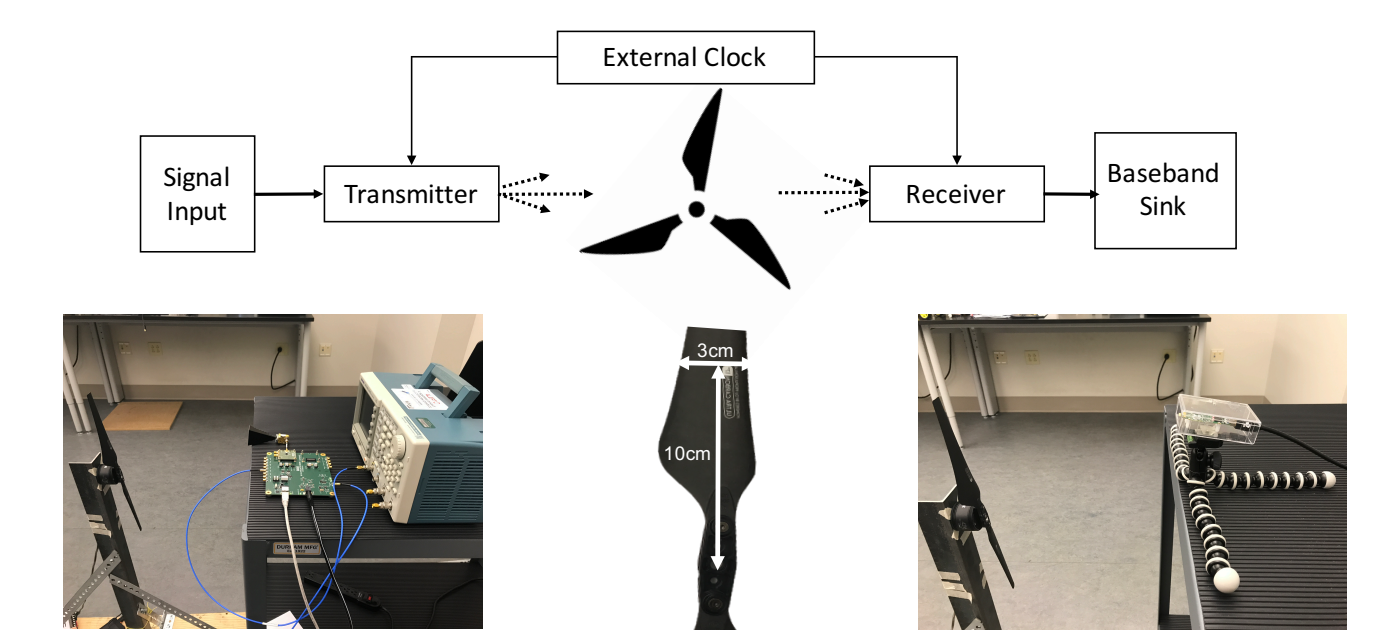
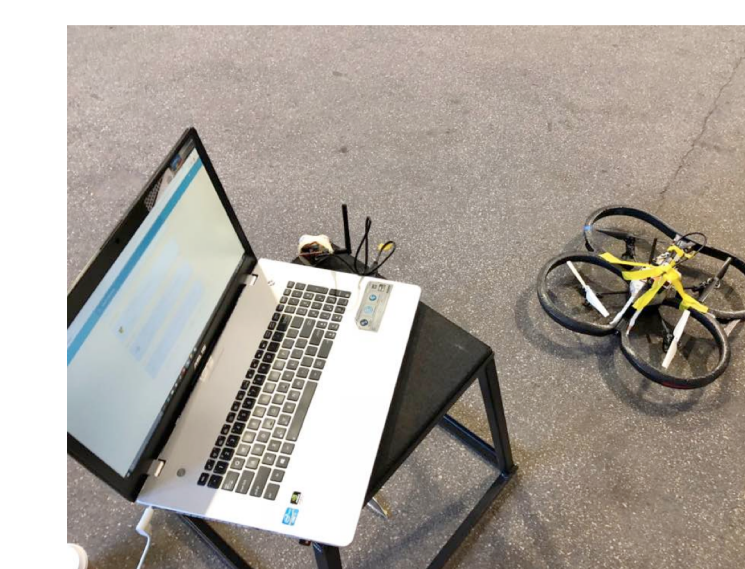
Challenge:

- Communications are needed for controlling physical dynamics in CPS.
- What is the communication requirement for the control?
- How to design the communication scheme?
- What if the physical dynamics is networked?



Experiments:

- UAV networks

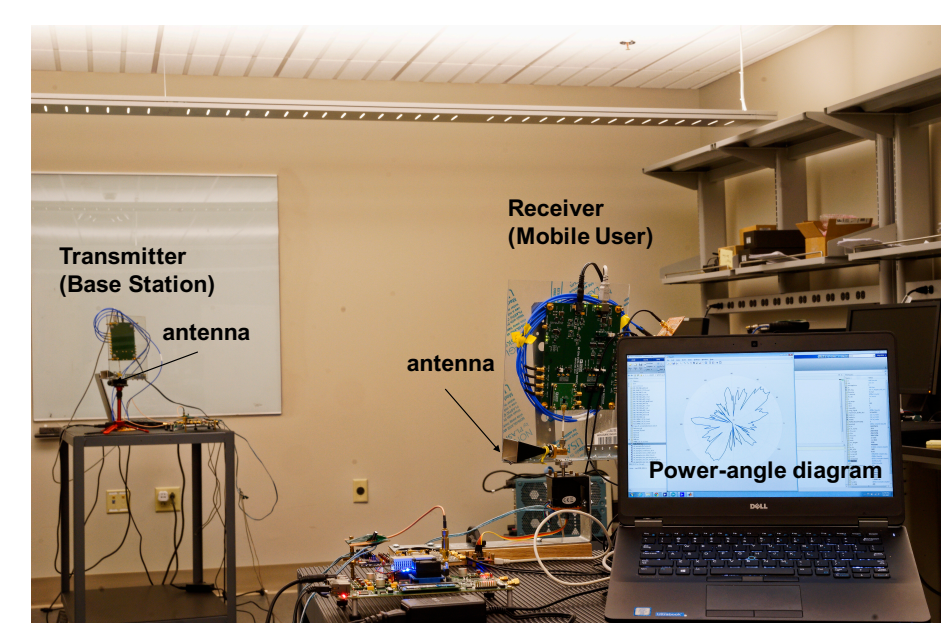


Communication in UAVs: we have tested the wireless communication performance on UAVs, in terms of packet drop rate

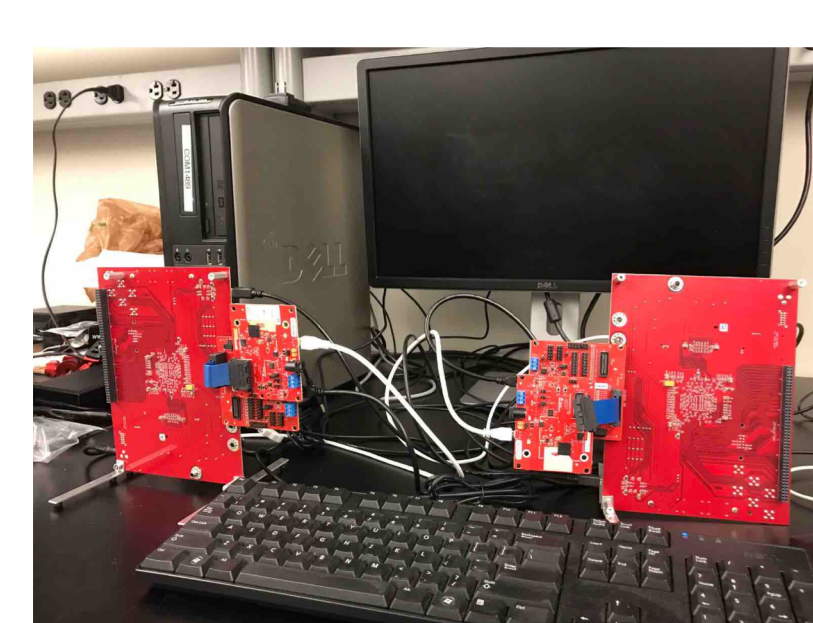
Millimeter wave for UAVs: We have tested the communication performance damage due to rotating blade in propeller UAVs

Solution:

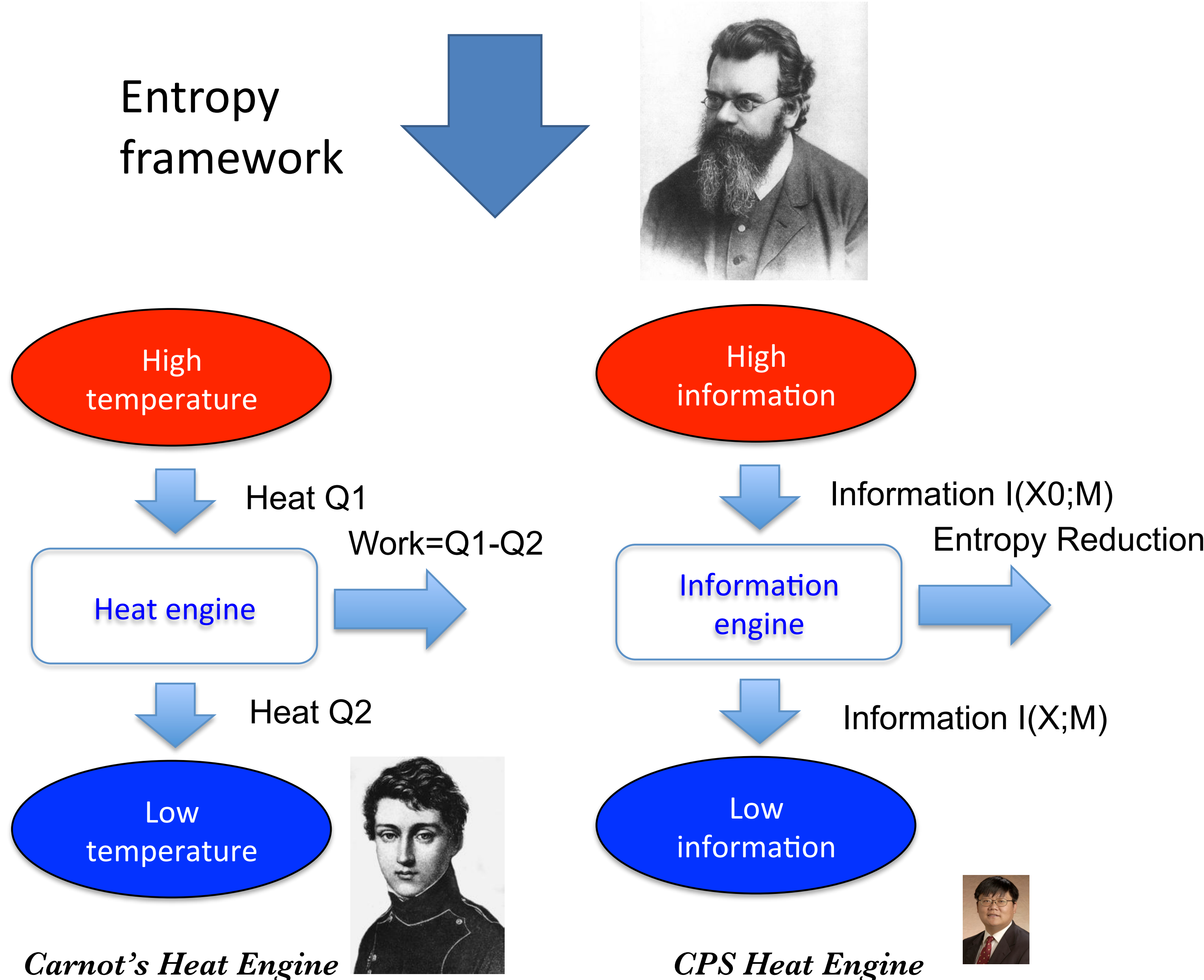
- Entropy framework: We use entropy to measure the messiness of the physical dynamics. Communications can be considered as negative entropy to compensate the entropy increased caused by random noise (ISIT'2015).
- We also study the propagation of entropy.
- A millimeter wave communication testbed is built to test CPS in 5G.



Millimeter wave communication testbed



Millimeter wave radar testbed



Heat engine efficiency

Information engine efficiency (CDC'2016)

Broader Impact:

- The theoretical framework helps to better understand and quantify the communication requirement in CPS. Particularly, it enhances the design of communications in smart grids.
- Two PhD students are involved in the project.
- Three high school students are involved in the project, focusing on the implementation of controlling unmanned vehicles.

