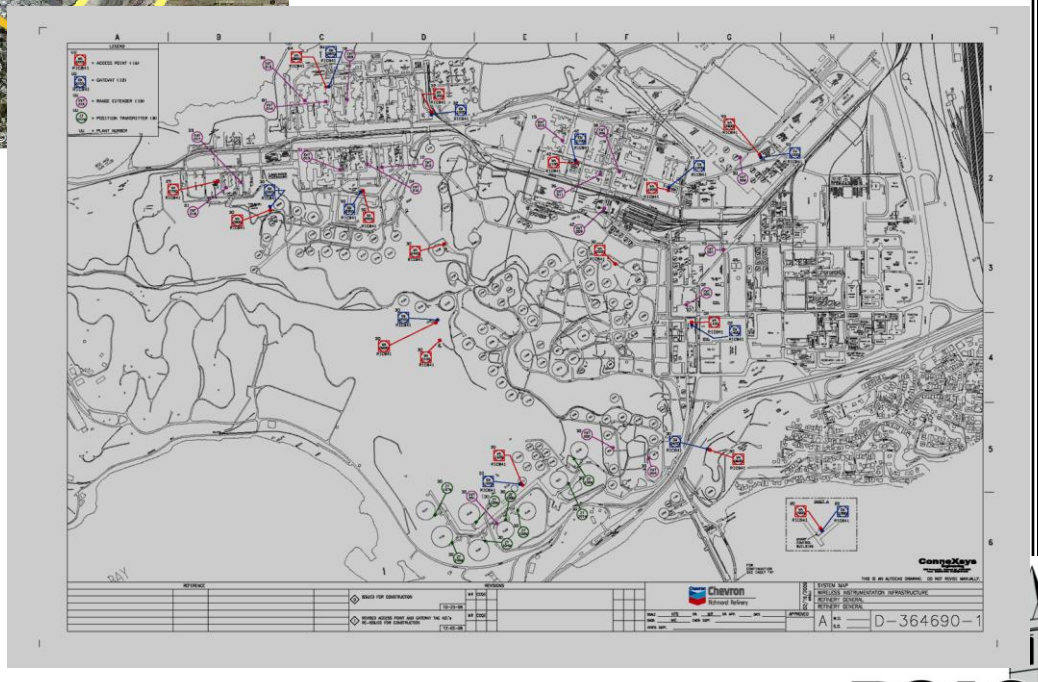
Wireless Sensing Applications for Critical Industrial Environments

Fabien Chraim
Prof. Kris Pister

Chevron Richmond

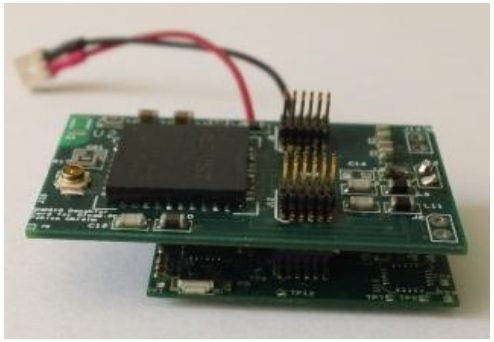
Richmond Refinery Wireless Umbrella

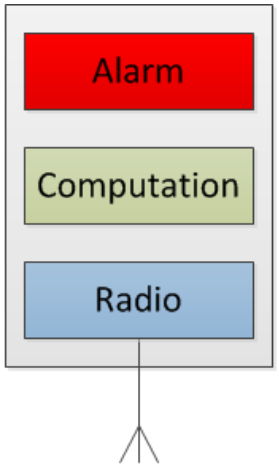


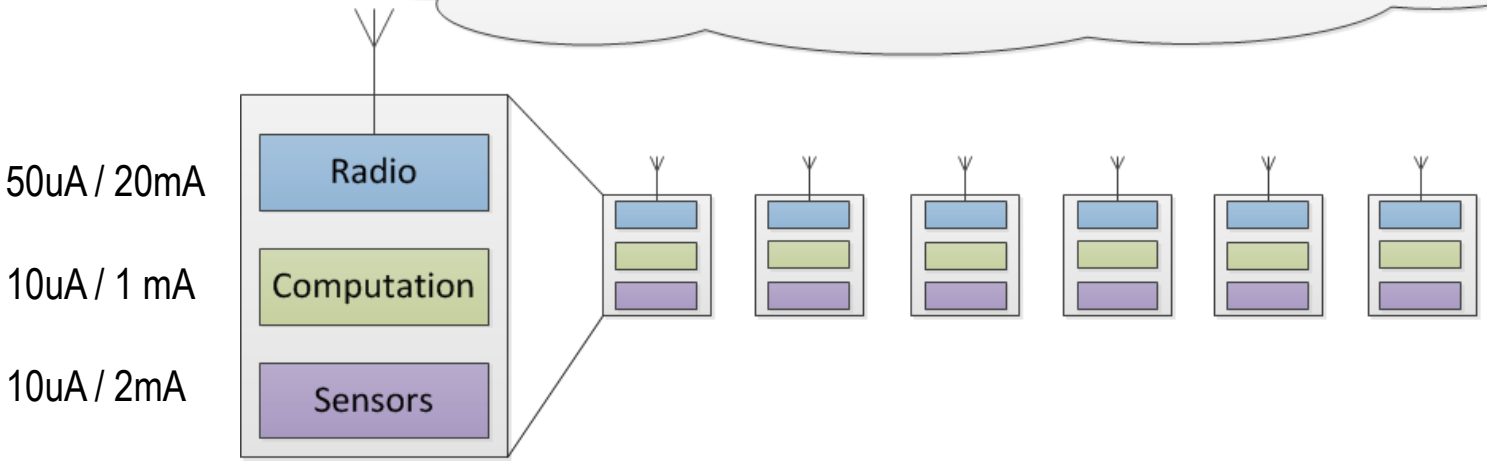
WirelessHART™

BSAC

Smart Fence – Proposed System Architecture

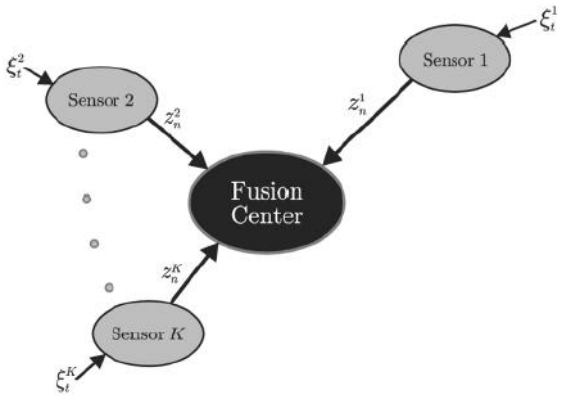


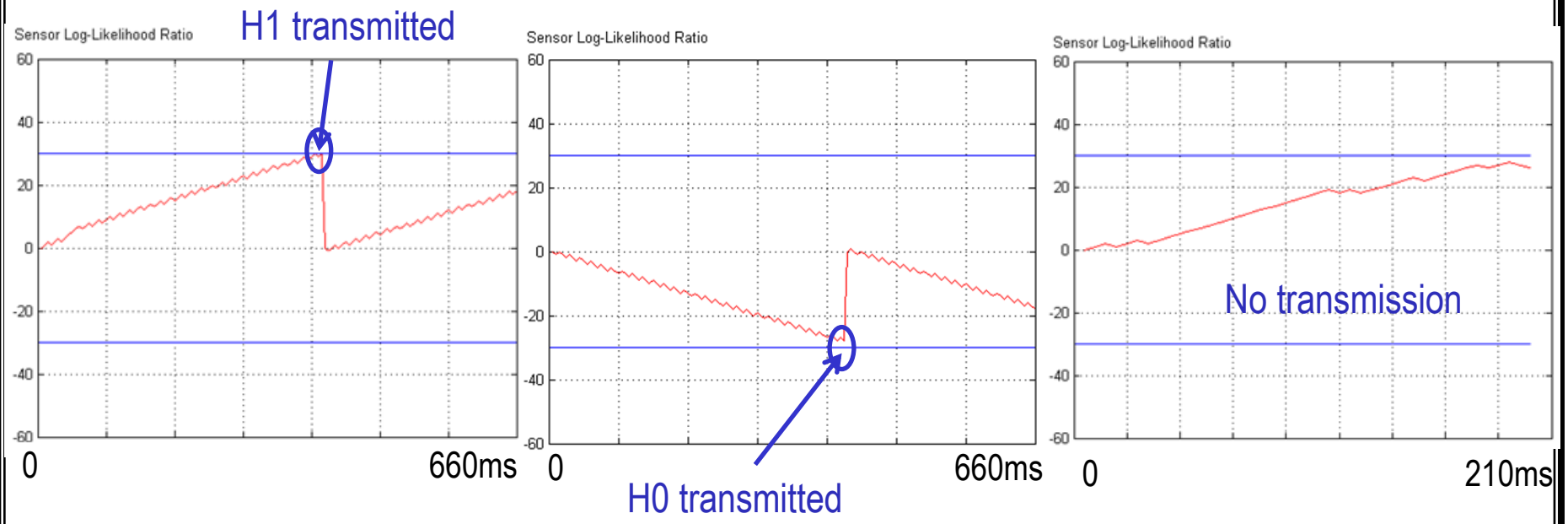




Sequential Hypothesis Testing

- Used in radar, clinical trials, channel selection…
- Decision making as samples are collected
- Two hypotheses
  - H0: no (or low) activity
  - H1: high activity

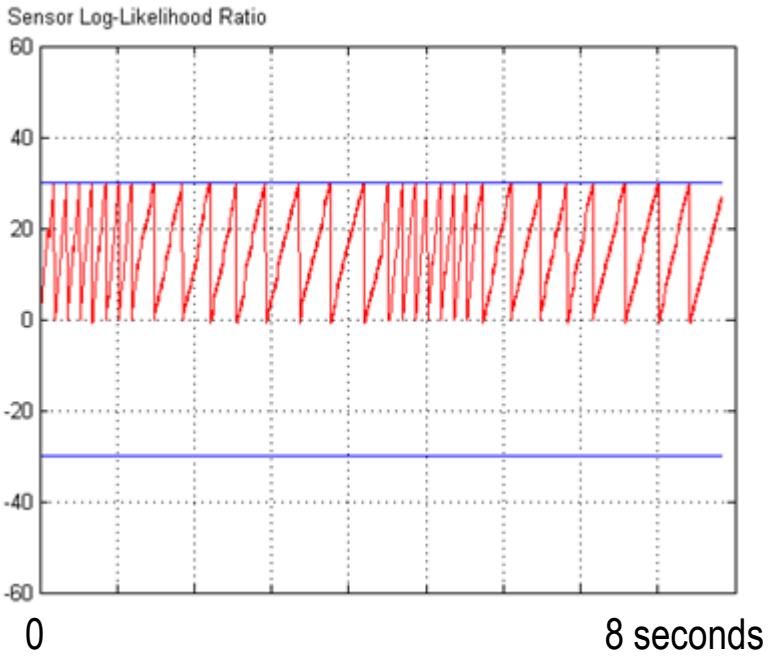


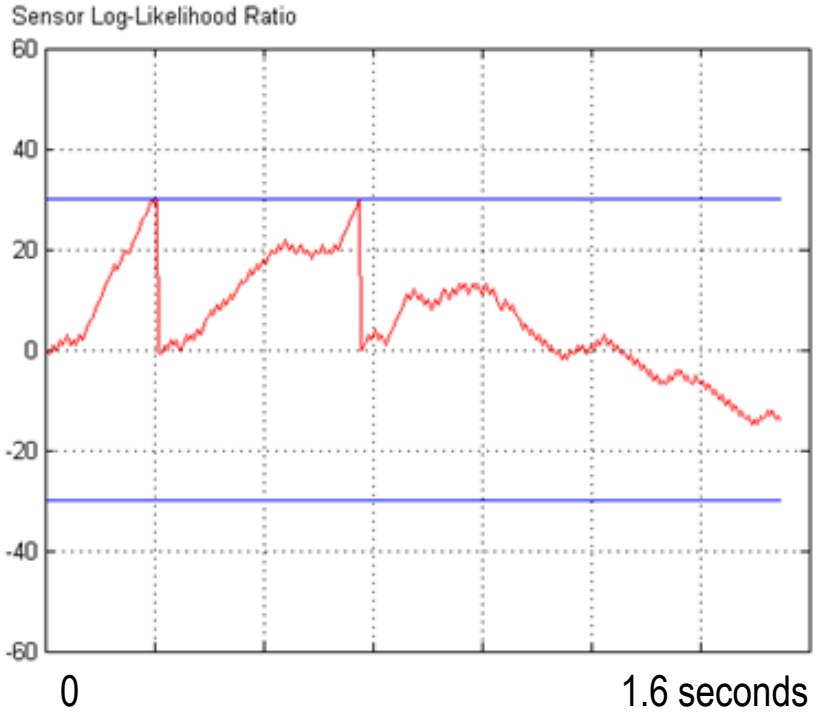


[1] A.Wald and J.Wolfowitz, "Optimum character of the sequential probability ratio test," Ann. Math. Statist., vol. 19, pp. 326339, 1948.

[2] Fellouris, G.; Moustakides, G.V.; , "Decentralized Sequential Hypothesis Testing Using Asynchronous Communication," Information Theory, IEEE Transactions on , vol.57, no.1, pp.534-548, Jan. 2011

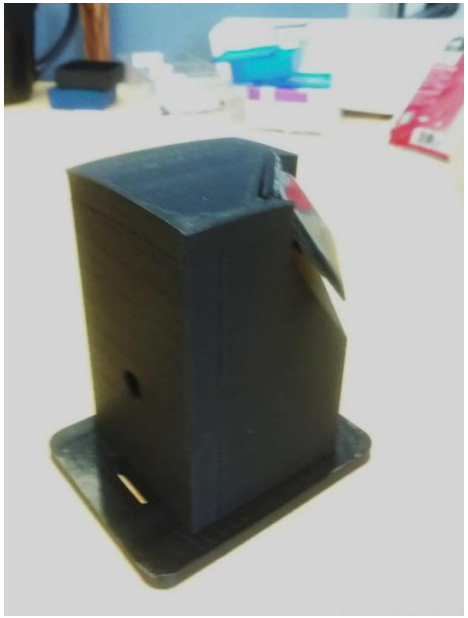
Sequential Hypothesis Testing – Example Outputs

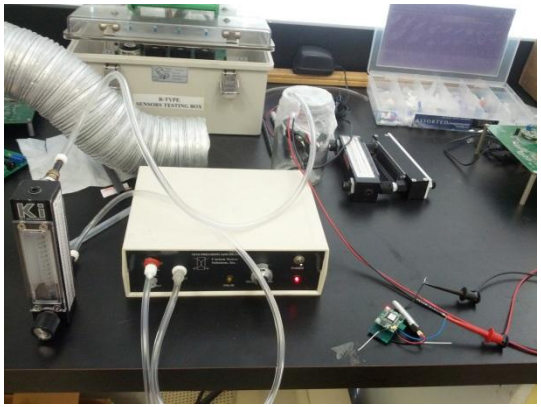


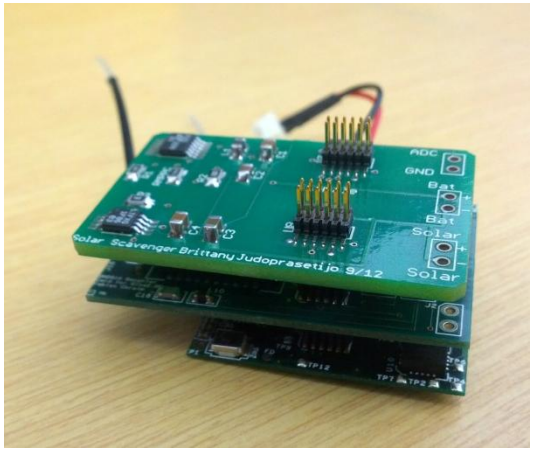


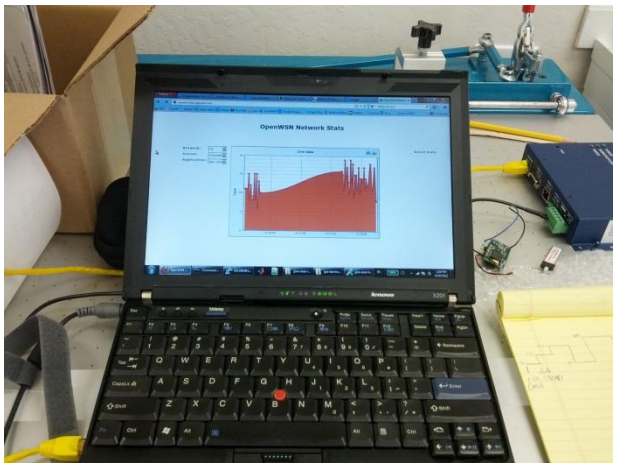
Smart Fence - Continuation

- Solar energy scavenging
- Enclosure redesign
- Air quality monitoring (H2S)

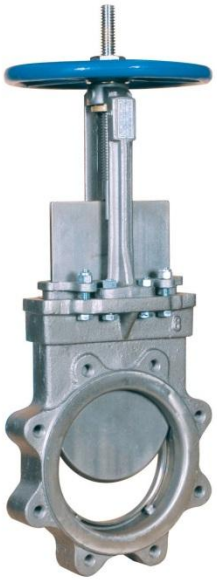


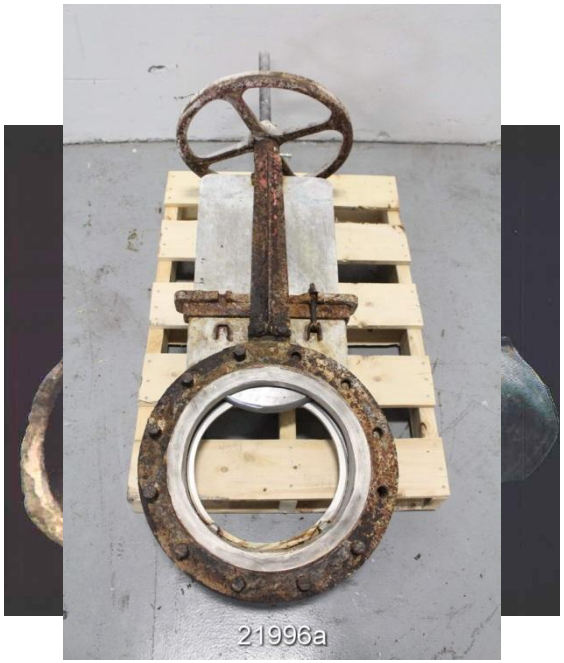






Valves

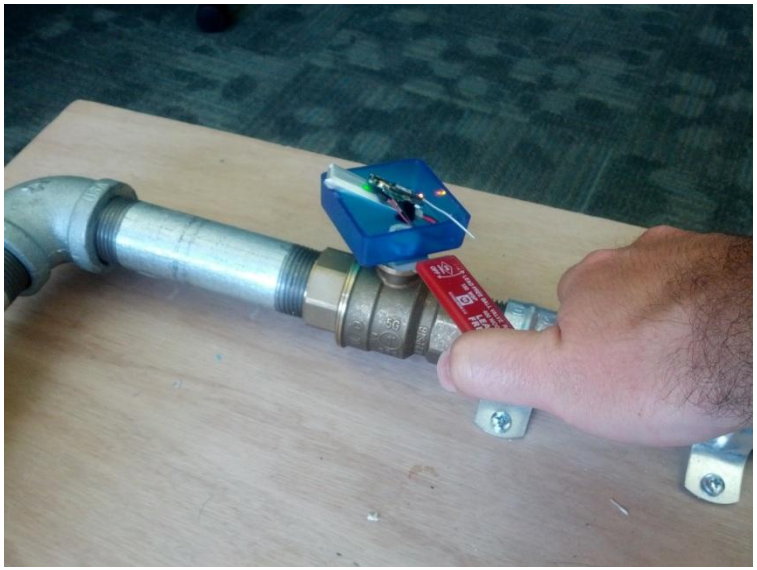




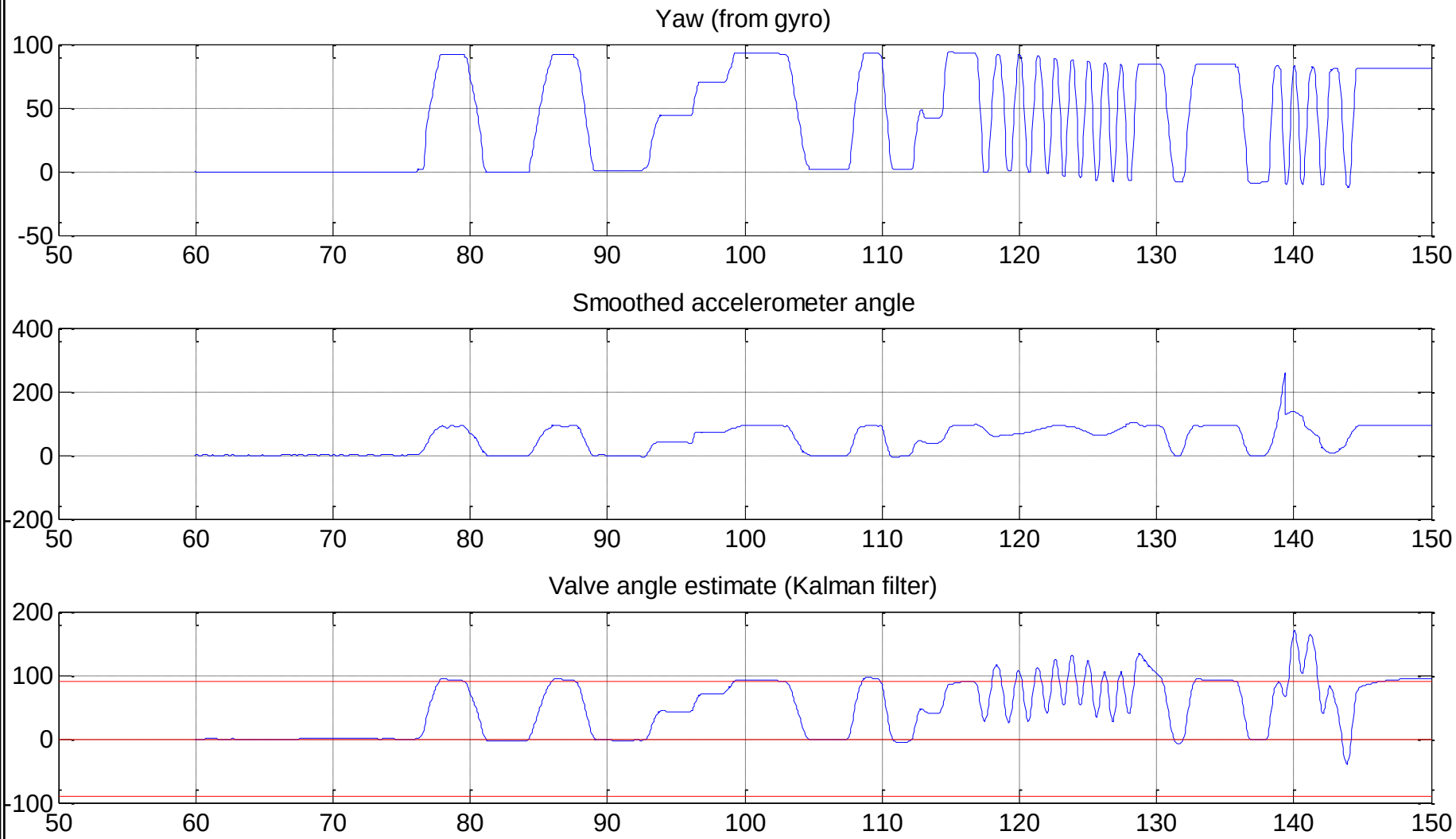
Valve Position Monitoring

- Why?
  - Detect abnormalities (alarms)
  - Better understanding of pressure gradients (plant-wide)
- Goals
  - Instrument a variety of valves (ball, butterfly, gate, globe)
  - Report position wirelessly
  - Accuracy of +/- 5 degrees (or 5%)
  - No calibration / Easy installation
  - Lifetime of ~5 years
  - Cheap

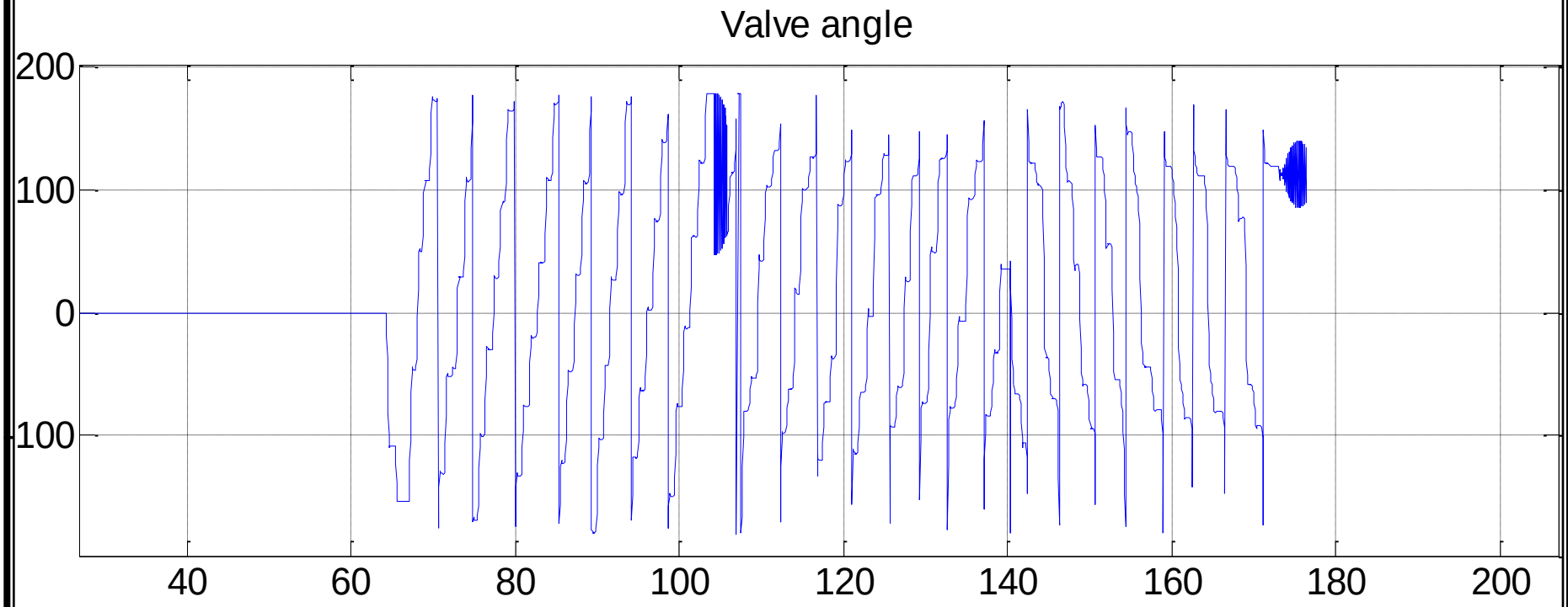
Valve Position Monitoring – Experimental Setup



Valve Position Monitoring – Data (quadrature)



Valve Position Monitoring – Data (rotary)



Project Outlook

- Large fence deployment (Intrusion + gas sensing)
- On-site valve testing
- Motor Vibration sensing (pumps, small electric motors…)