

Signal Processing Research in Precision Agriculture and Related Areas

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Today's Topics

- What is signal processing?
- What projects interest my group?
- How is this related to data science?
- Using python for data science.

Signal Processing

- Signals are: Math representations of measurements of physical and other phenomena – usually defined by example:
 - + A sequence of voltmeter measurements wrt time
 - + Price of stocks or bonds over the course of a day, week, etc.
 - + Daily temperature readings.
 - + An image, a video, an audio file.
- Signal processing:
 - + Computational algorithms for modifying or extracting information from signals.
 - + Design of systems which sense signals, transmit/receive, store, process signals.

Data logger

Some Signal Processing Systems



Wifi access point



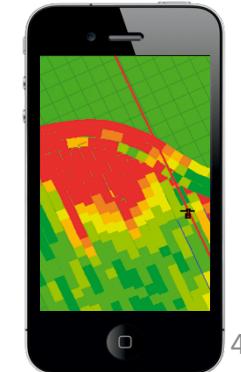
Software defined radio



Pressure sensor with wireless connectivity



Time domain reflectometer used to measure soil density and water content

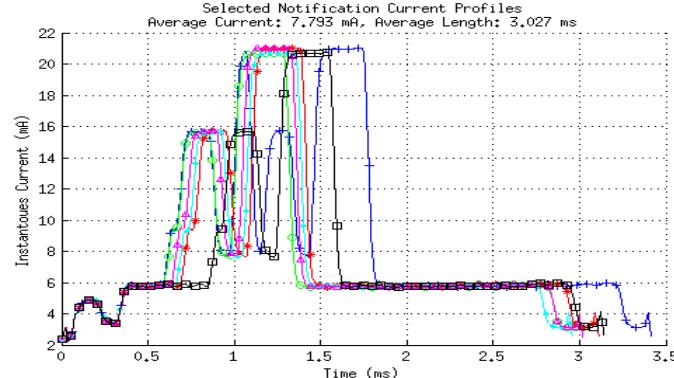


Smartphone

Systems and Signals Examples



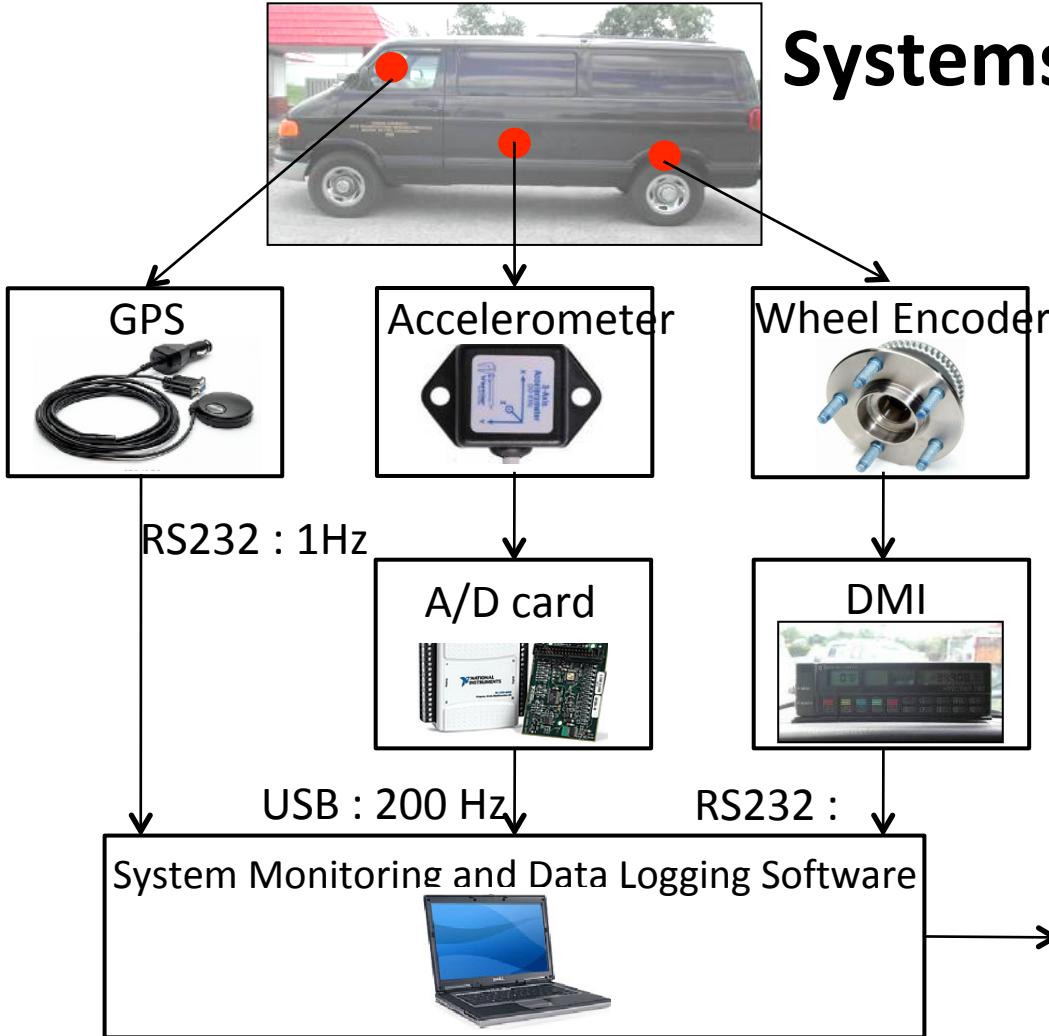
Current vs. time traces in a
Bluetooth IC as it transitions from
standby to connection state.



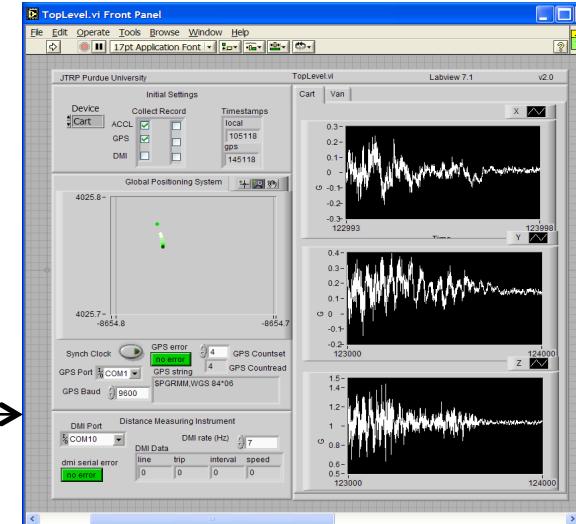
Corn futures market
since 1960



Systems and Signals Examples



$$\begin{aligned} & a_x(t) \\ & a_y(t) \quad \text{for } t \in \mathcal{R} \\ & a_z(t) \end{aligned}$$



Systems and Signals Examples

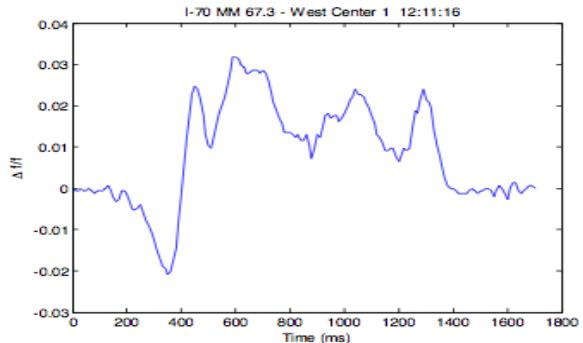
- Traffic signal control and coordination
- Inductive loop sensor systems and vehicle signal loggers
- Magnetic perturbation sensor systems



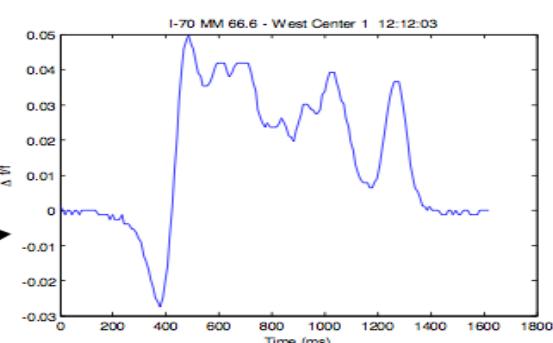


← UPSTREAM SITE

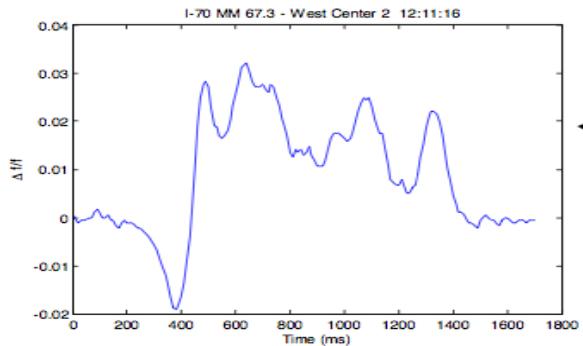
DOWNTREAM SITE →



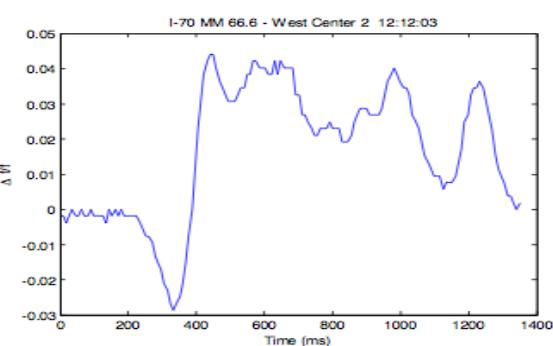
← UPSTREAM Loop 1



DOWNTREAM Loop 1 →

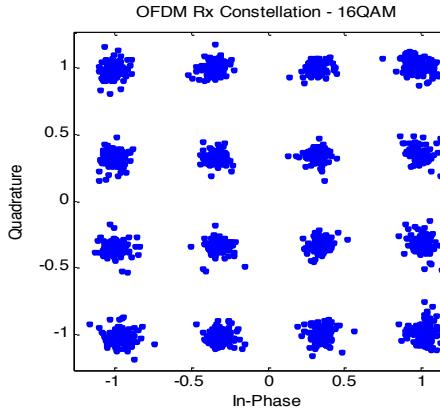


← UPSTREAM Loop 2

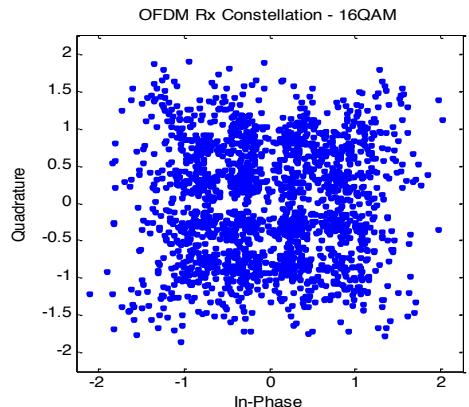


DOWNTREAM Loop 2 →

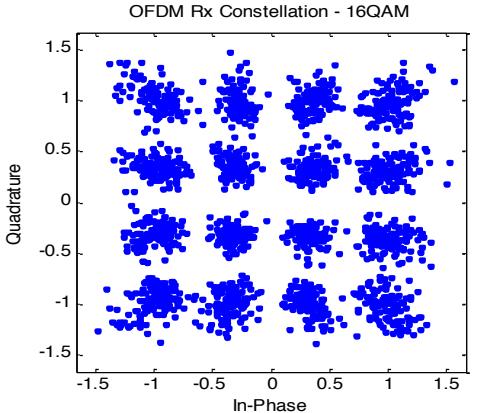
Systems and Signals Examples



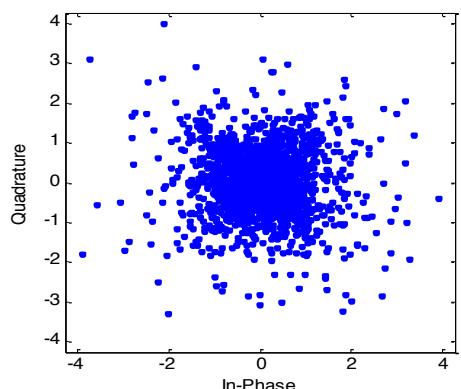
$$\varepsilon = 0$$



$$\varepsilon = 0.1
(\sim 15.6\text{kHz})$$



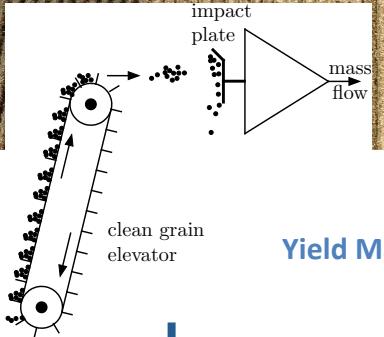
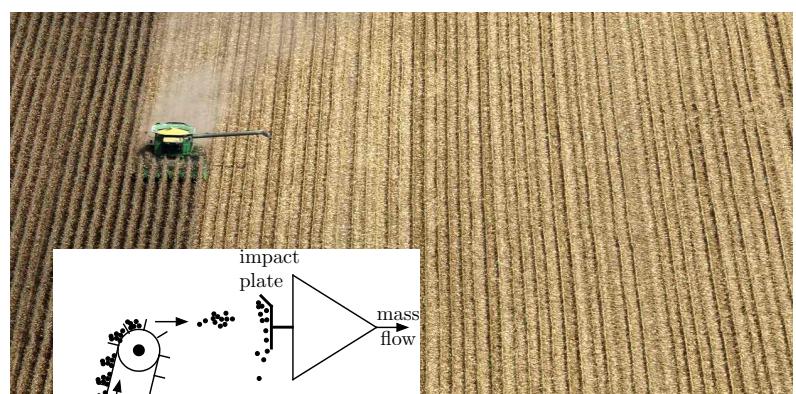
$$\varepsilon = 0.05
(\sim 7.8\text{kHz})$$



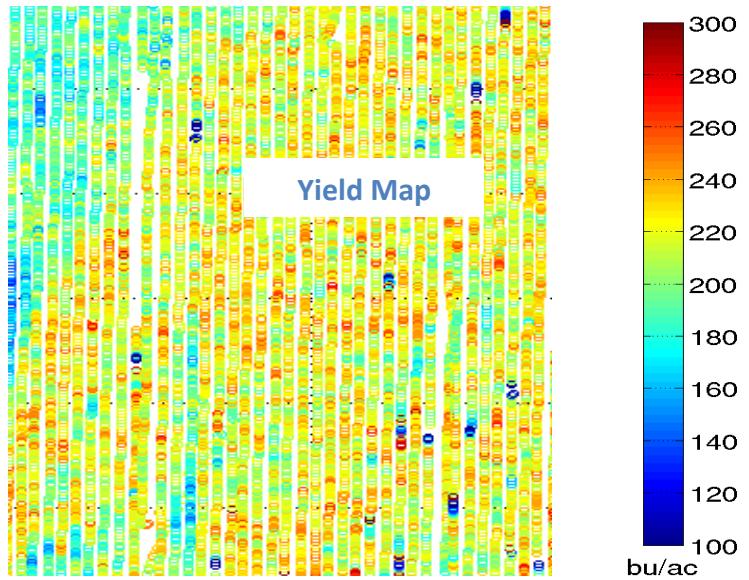
$$\varepsilon = 0.2
(\sim 31.2\text{kHz})$$



Systems and Signals Examples



Yield Mass Flow Sensor



$$y(x, y)$$

$x \in \mathcal{R}$ (easting)
 $y \in \mathcal{R}$ (northing)