Event Detection

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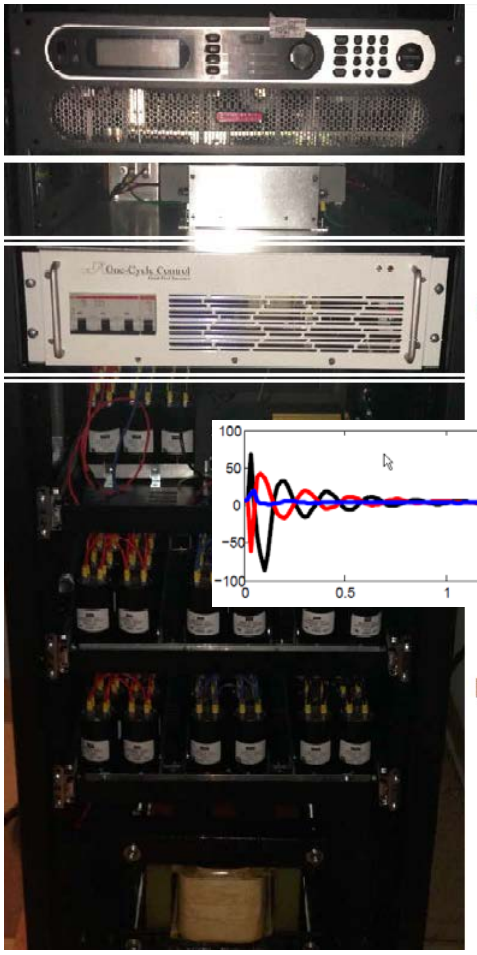
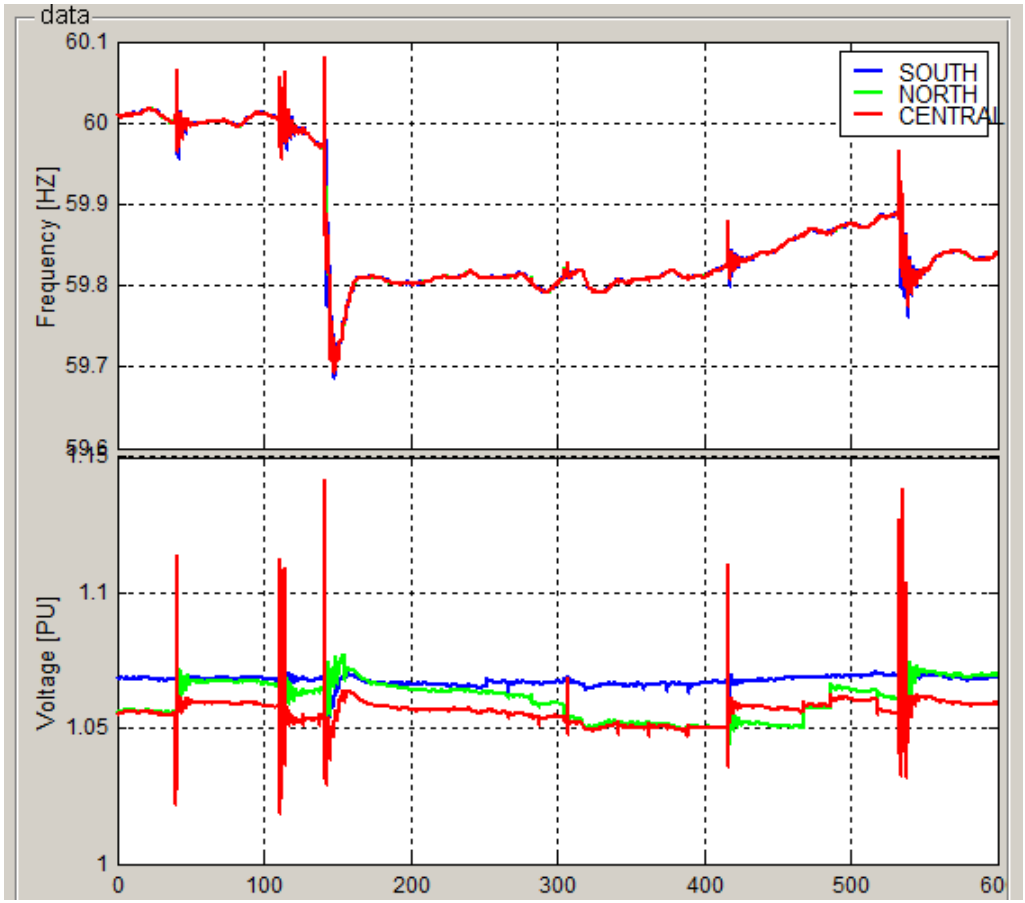
- Research done at “Control Group” at the Dept. of Mechanical and Aerospace Engineering at UCSD
- Current collaborations with
  - Center for Energy Research (CER)
  - San Diego Supercomputer Center
  - OSIsoft
  - SDG&E
- Research focus: development of scientific and engineering analysis of PMU data and application of real-time applications in signal processing & automatic control



PMU data (Frequency/Voltage/Power) to observe events

- Can we automatically detect an event? (identify timing & trigger)
- Can we automatically characterize the event? (reduce event data to finite number of parameters)
- Can we automatically identify the event? (data mining of parameters to classify event)



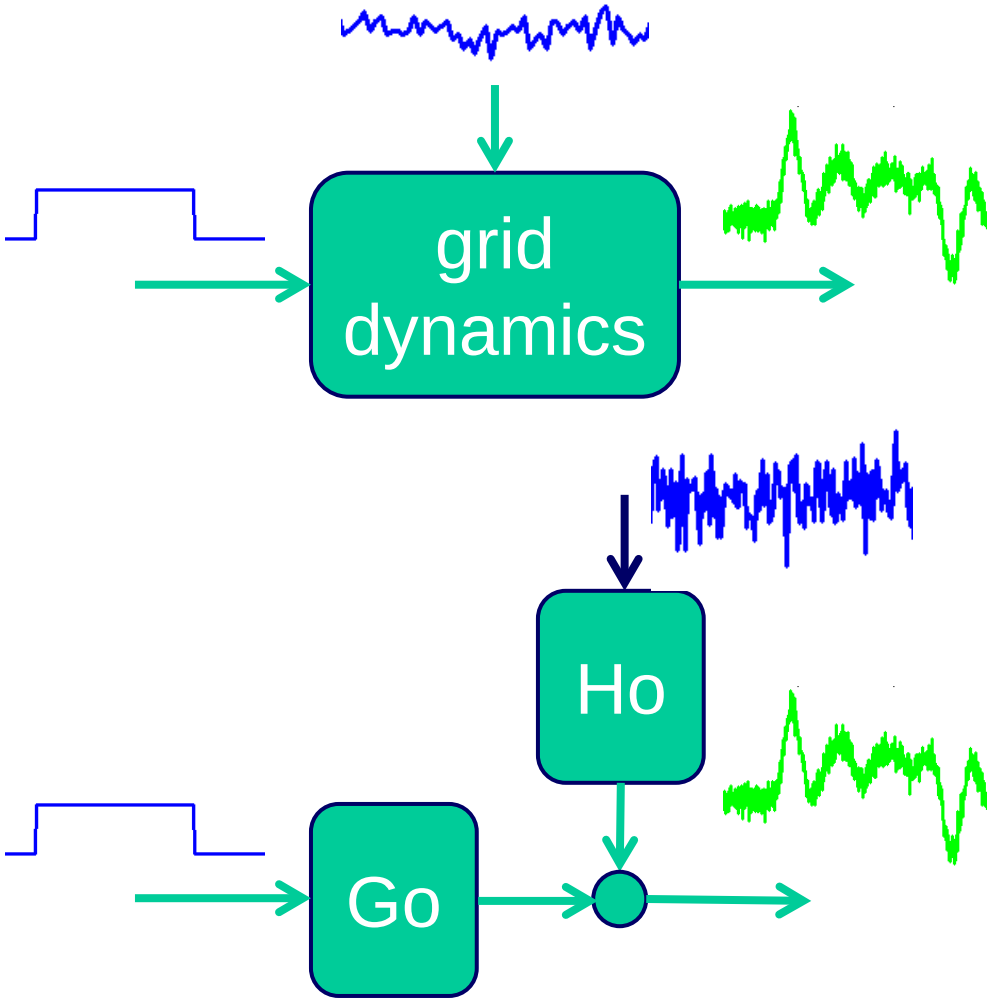
Outline of Remainder

- Detection of Events via Filtered Rate of Change (FRoC)
  - Auto Regressive Moving Average (ARMA) filter of ambient data
  - Rate-of-Change filter to create FRoC signal to detect change

Detection of Events

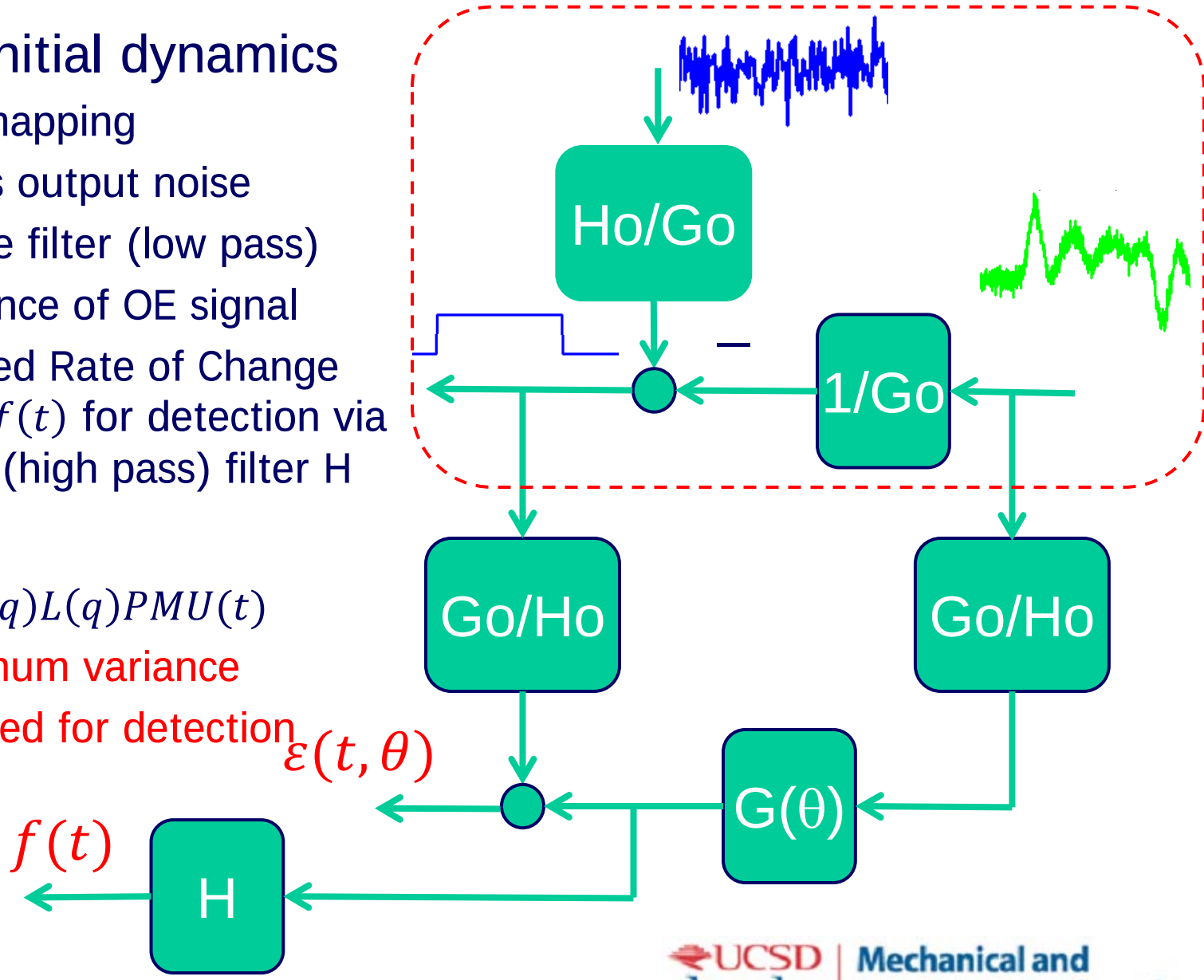
Approach is based on dynamic and statistical analysis:

- Assume PMU observation is linear combination of:
  - Main event signal filtered by grid dynamics
  - Small/random events filtered by grid dynamics
- What's new here:
  - Use knowledge on main modes (grid frequency and damping)
  - Compute optimal detection signal by reconstruction of (filtered) main event signal



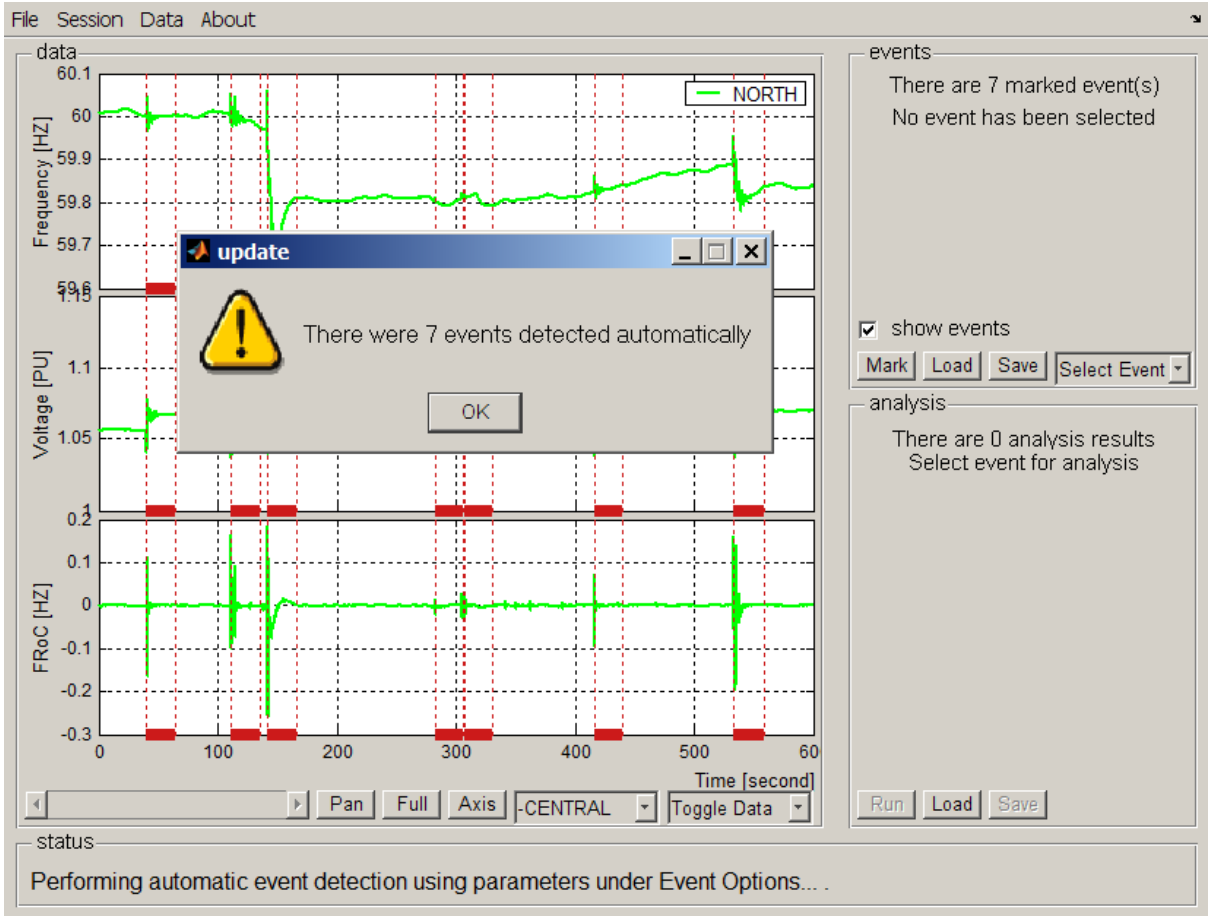
Detection of Events

- Starting from initial dynamics
  - Invert signal mapping
  - Model noise as output noise
  - Add fixed noise filter (low pass)
  - Minimize variance of OE signal
  - Define a Filtered Rate of Change (FRoC) signal $f(t)$ for detection via differentiation (high pass) filter H
- End Result:
  - $f(t) = H(q)G(q)L(q)PMU(t)$
  - $f(t)$ has minimum variance
  - $f(t)$ can be used for detection



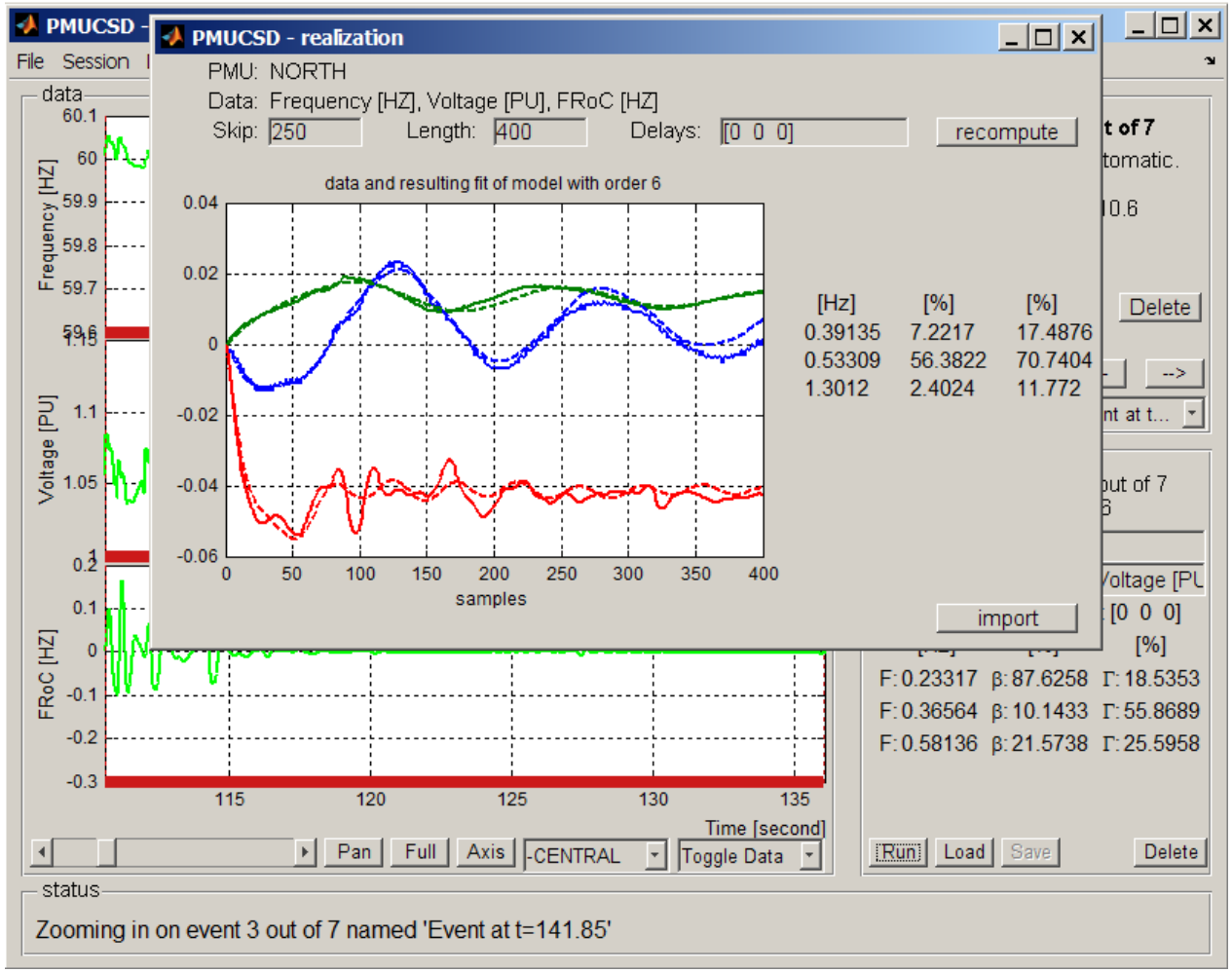
Detection of Events

- Software Development for Event Detection:
  - Matlab GUI for processing of PMU data
  - Matlab scripts for real-time analysis
  - Porting to .NET application for OSIsoft PI app.
- Live demo of software (later?)

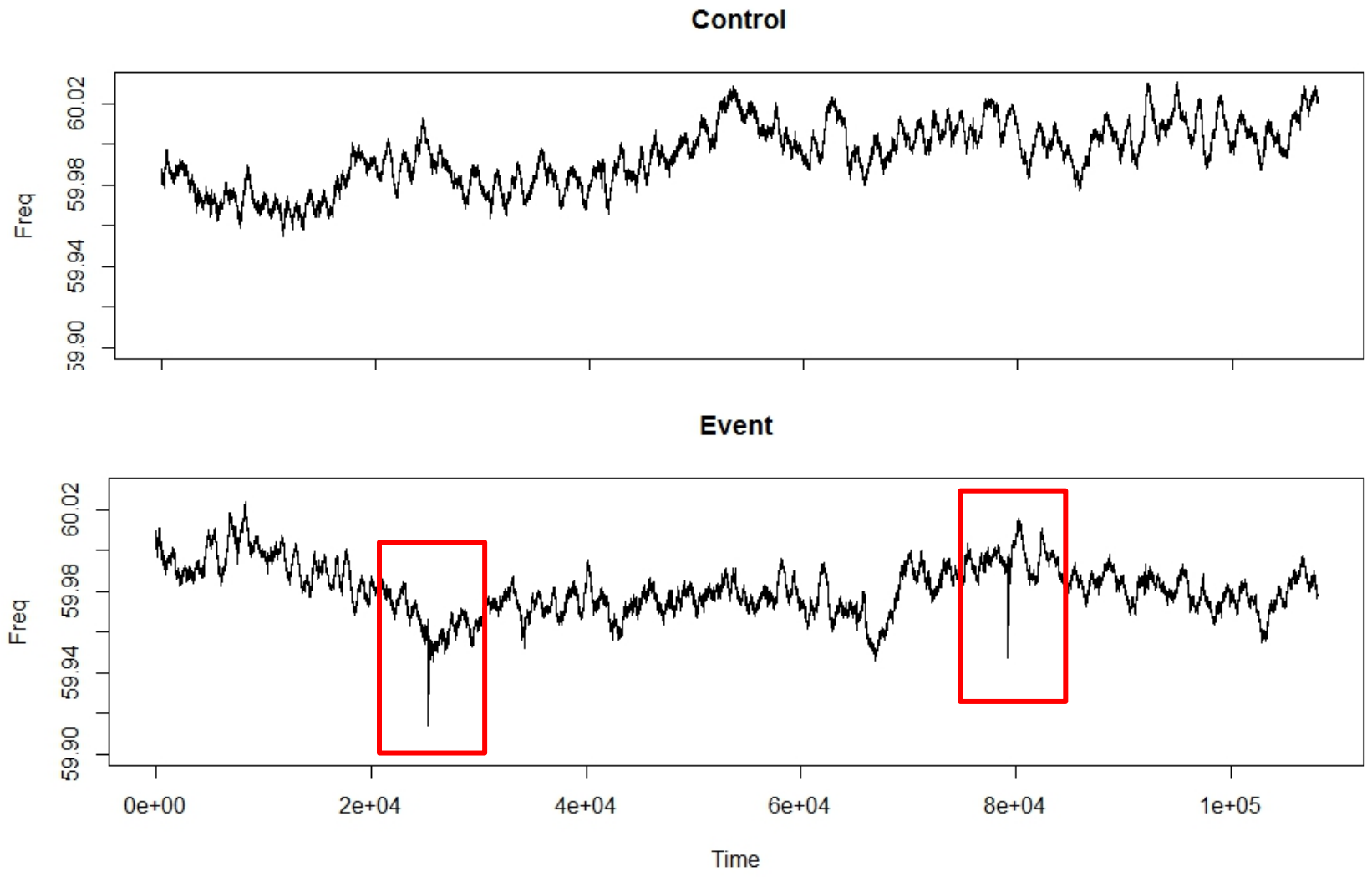


Detection of Events

- Software Development for Event Characterization:
  - Same Matlab GUI also used for processing of PMU data
  - Matlab scripts for real-time analysis
  - Porting to .NET application for OSIsoft PI app.
- Live demo of software (later?)



PMU Frequency Data



Demonstration
At
Vendor show