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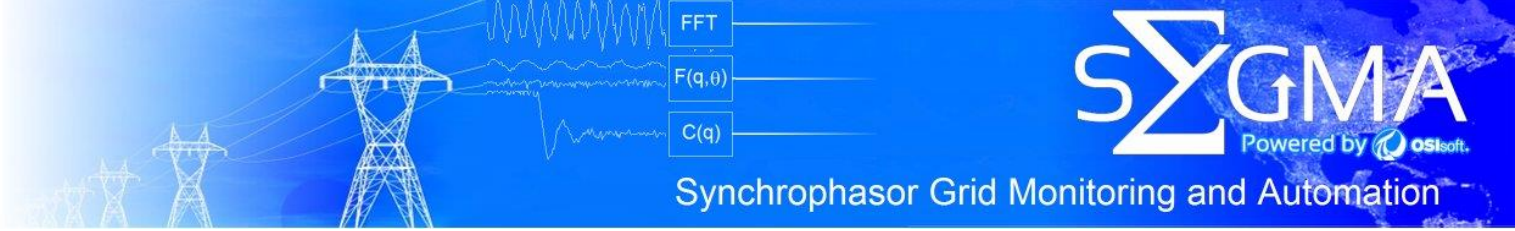

The SyGMA lab powered by OSIsoft

http://sygma.sdsc.edu/

Presented by **Prof. Raymond de Callafon**
University of California, San Diego

UC San Diego
SDSC
SAN DIEGO SUPERCOMPUTER CENTER

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San Diego Supercomputer Center (SDSC) at UCSD

- Organized Research Unit (ORU) and National Laboratory at UC San Diego
- Considered a leader in
  - data-intensive computing
  - cyberinfrastructure

- Provides resources, services, and expertise to the national research community
- Co-located “green” data center

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San Diego Supercomputer Center (SDSC) at UCSD

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The SyGMA lab at SDSC, UCSD

R&D in the emerging technology on electric grid instrumentation by development of new data processing, dynamic modeling and model validation tools for Synchrophasor Grid Monitoring and Automation of electric networks.

OSIsoft. — Data storage and Processing

NATIONAL INSTRUMENTS — Hardware and Control Algorithms

SDGE A Sempra Energy utility — Applications and Control Algorithms on RTDS

SDSC SAN DIEGO SUPERCOMPUTER CENTER — Facilities and Business Services

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Challenges for Grid Instrumentation and Automation

- We keep track of electric power flow and quality:
  - Manually in “control” rooms
  - Automatically on “small” scale systems

- More users, more renewables, “faster” monitoring:
  - Phasor Measurement Unit (PMU) producing data at 60Hz
  - Collect PMU data and present it usefully…
  - Can we automate? (think “high frequency” trading…)

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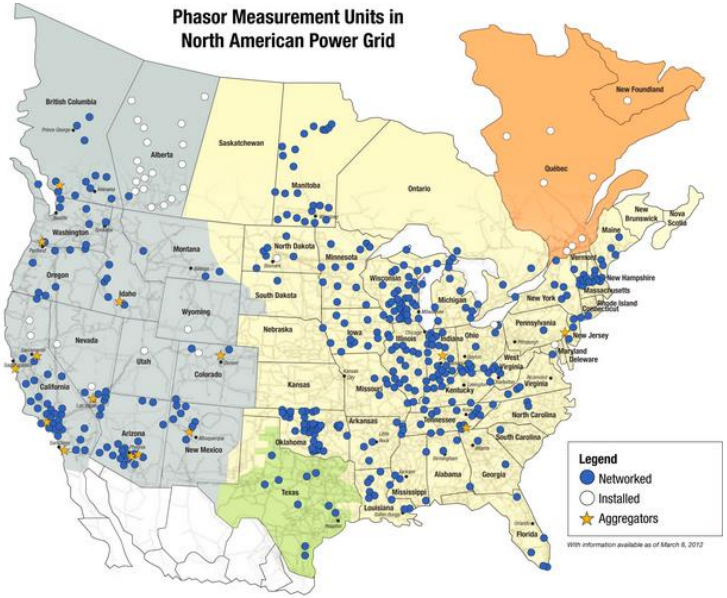
Challenges for Grid Instrumentation and Automation

PMUs generate “a lot” of data

- 60Hz, 14 channels
- C37 IEEE format
- Time synchronization

Data management, feature extraction

- Secure import PMU data
- Automatic Event Detection
- Grid Asset Management



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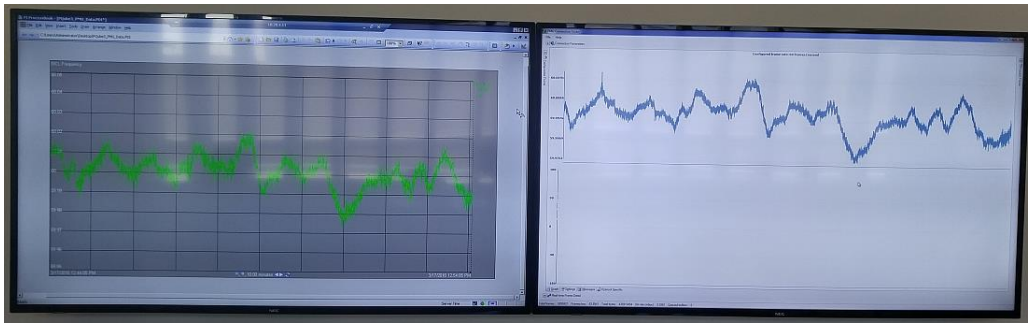
Key Role of OSIsoft PI System

- PI Interface for C37 data stream from PMUs
- PI Data Archive & PI Asset Framework for PMU data storage
- PI Processbook for Display of Grid Disturbance Events



- PI DataLink for download of data (classes/courses)
- PI to PI Interface (with SieGate)
- Advanced Computing Engine and Event Frames for analysis

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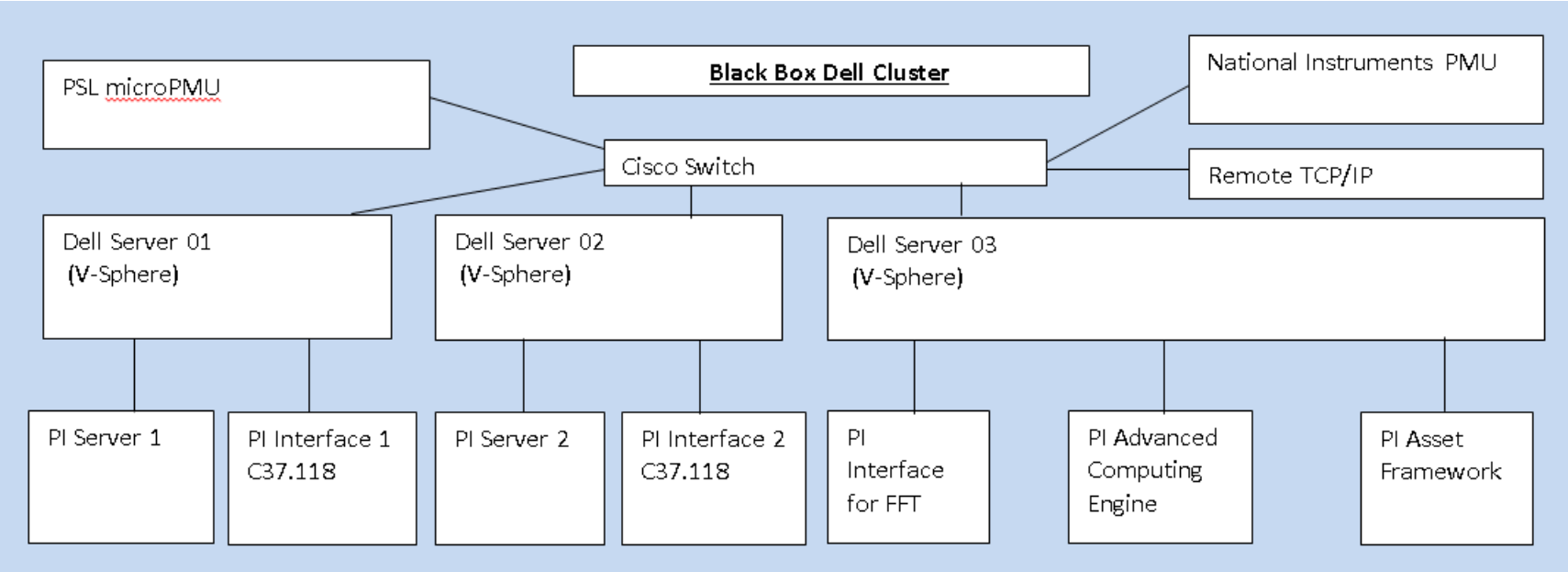
PI System Architecture



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Capabilities of PI system at SyGMA lab

Direct use of products

- Acquisition of PMU data with IEEE C37.118 Interface
- PI to PI interface (with SieGate) for external PMU data transfer
- PI Processbook for Display

Additional Development & Expansion

- Automatic event detection using
  - Windowed Fast Fourier Transform
  - Filtered Rate of Change Signals
- Event characterization with oscillation analysis and realization

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Illustration of Event Detection

Parallel FFT (PFFT) algorithm

- Used fixed length FFT (e.g. N=128 FFT)
- Apply to filtered and downsampled data in parallel
- Robust against data “drop outs”
- Useful for detection of sustained oscillations

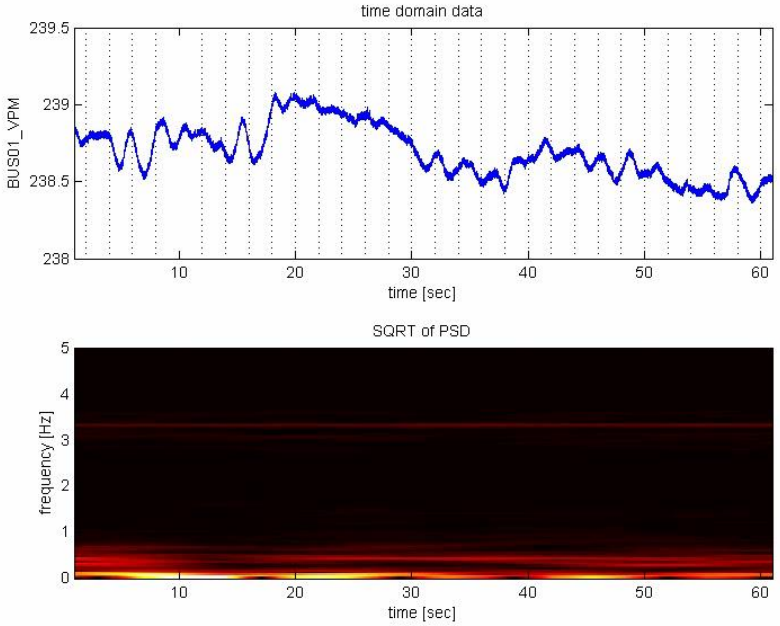

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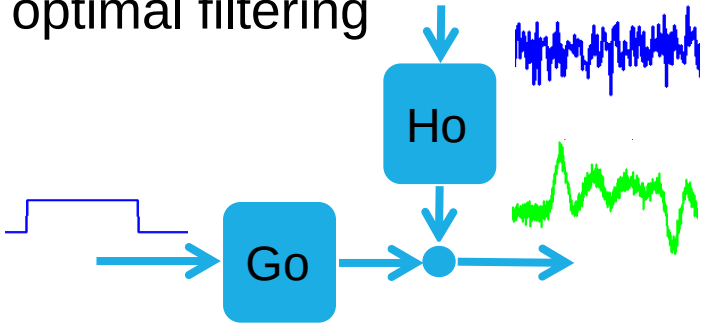
Illustration of Event Detection

Filtered Rate of Change signal

- Computed in real-time via optimal filtering



- Assume PMU observation is linear combination of:
  - Event signature
  - Small/random events

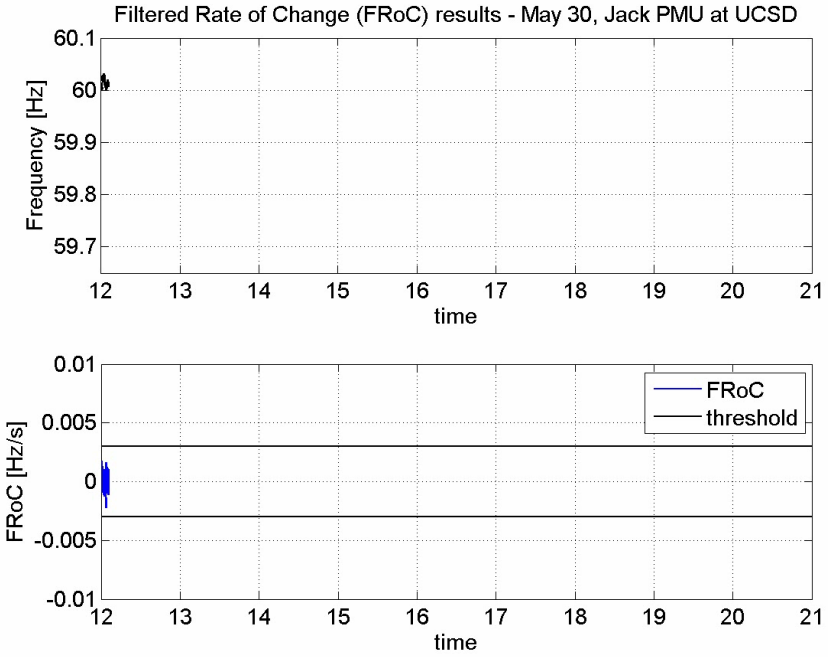


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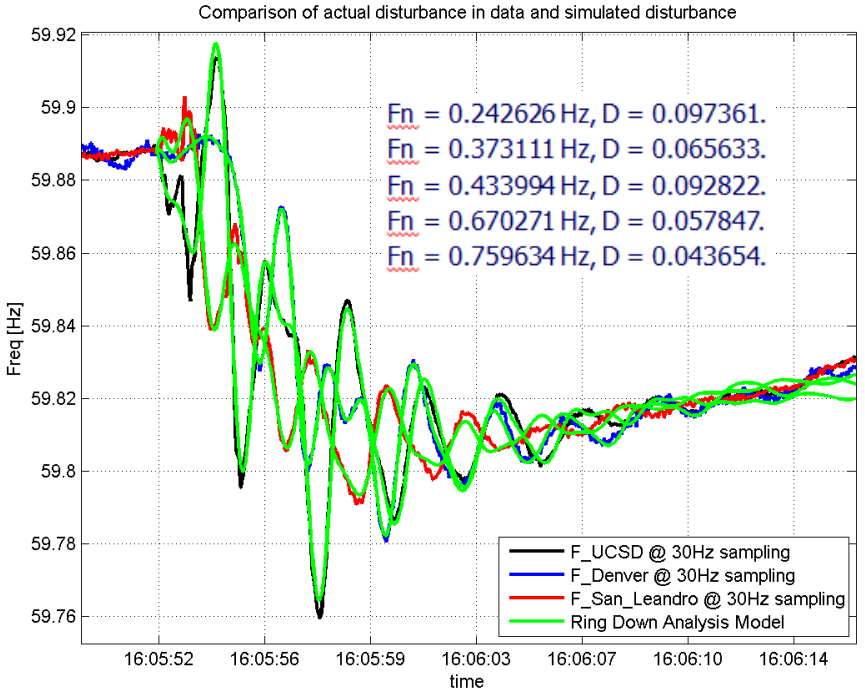
Illustration of Event Characterization

Realization Algorithm

- Directly “fit” model on data
- Reduce events to finite number of parameters:
  - Time Stamp
  - Frequency
  - Damping
- Compare data with model
- Use model for dynamic control



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Impact and Visibility of SyGMA lab

- OSIsoft products for PMU data management
- Domain specific applications for PMU data
  - Event Detection
  - Event Characterization
  - Equipment & Asset monitoring
  - PMU Data quality monitoring
- Use of PI System software and PMU data in classroom
  - Students learn PI System management
  - Courses on real-time signal processing
- Use of OSIsoft products for Grid Monitoring and Automation

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Wrap up

- New lab at SDSC, UCSD
- Focus on Grid Monitoring and Automation
- Full use of OSIsoft existing products
- Development of new applications integrated in PI System

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The SyGMA lab at UCSD – PI system for grid monitoring and automation

COMPANY and GOAL

SyGMA lab provides R&D for Synchrophasor Data Signal Processing and aims to develop **applications for phasor data to improve grid efficiency and renewable energy penetration**

UC San Diego

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CHALLENGE

Synchrophasor data from grid operation often only available at utility company

- Large volumes of phasor data
- Not clear what features can be extracted from phasor data
- Limited training in use of PI System and phasor data processing

SOLUTION

Development of new R&D lab at SDSC, UCSD to bring together utility and academics

- Lab powered by PI system
- Secure porting of phasor data
- Local phasor data on campus
- Teaching environment

RESULTS

New phasor applications, IP development and training of next generation of students

- Collaboration between industrial partners
- Data integration for grid monitoring and automation

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谢谢

Danke

Gracias

Merci

Thank You

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Спасибо

Obrigado

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