DOE/OE Transmission Reliability Program

PNNL-SA-118520

Improved Oscillation Detection for Alarming and Daily Summary Reports

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Overview

- Background
- Project Objectives
- Method Implementation
- Deliverables
- Project Continuation

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Background

- **Well-damped power system oscillations are common and harmless**
- **Sustained oscillations**
  - Natural/Modal – stability problem
  - Forced – equipment malfunction
- **Response**
  - Natural – topology/dispatch adjustment
  - Forced – identify and disconnect source
  - Requires detection

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Background

- **Oscillation Detection**
  - Aided by PMU networks
  - Goal: excellent detection with few false alarms
  - Multi-channel spectral-coherence and periodogram methods developed in FY15 under the CERTS-funded Mode Meter project
- **Data Integrity And Situational Awareness Tool (DISAT)**
  - Applies statistical analyses to search for power system events in large volumes of data
  - Original implementation included oscillation detection
    - Single-channel spectral-coherence algorithm
    - Relied on DISAT's statistical analyses
  - Deployed for testing at BPA's synchrophasor lab

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Objectives

- Finalize multi-channel methods with improved detection performance
- Implement within the existing DISAT framework
- Report results in a highly tractable form
- Deploy for testing

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DISAT Implementation

- **Approach**
  - Overviews at the month, day, and frequency levels
  - Separate occurrences of an oscillation are reported together
  - Oscillations ranked based on evidence (amplitude) and duration
  - Handles archived and incoming data
- **Algorithms**
  - Multi-channel spectral coherence
  - Multi-channel periodogram
- **Visualizations**
  - Improved visualizations capture geographic, frequency, amplitude, and phase characteristics over time

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BPA DISAT Analysis Software

Please select appropriate tab to complete desired task.

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Home | Atypicality Exploration | Historical Analysis Results | Raw Data Viewer | Cluster Membership | Data Quality Displays | Forced Oscillations

Welcome to the Bonneville Power Administration Data Integrity and Situational Awareness Tools Analytic Software

This software was designed to provide analysis of PMU data obtained by the BPA.The software provides cluster analysis, real time analysis, historical analysis, data quality reports, and atypicality exploration. Cluster analysis provides you with information to analyze the different clusters including the percentage of data including in each cluster. Real time analysis allows you to select current dates to analyze the most recently uploaded data. The user can view graphs of all six different analysis types at one time, take in depth looks into each individual type, and a summary of the results. The historical analysis allows you to recall previous months of analyzed data results and obtain the graph and atypicality tables for the specified month. Data quality displays provide information about the data quality filtering that occurs on the raw data. Atypicality Exploration allows deeper investigation into where atypicalities are occuring in the data for further analysis. As well, the user may view the performance envelope for specific variables. This includes the use of interactive tools to review the analysis results. For additional and more detailed information, please refer to the software's user guide.

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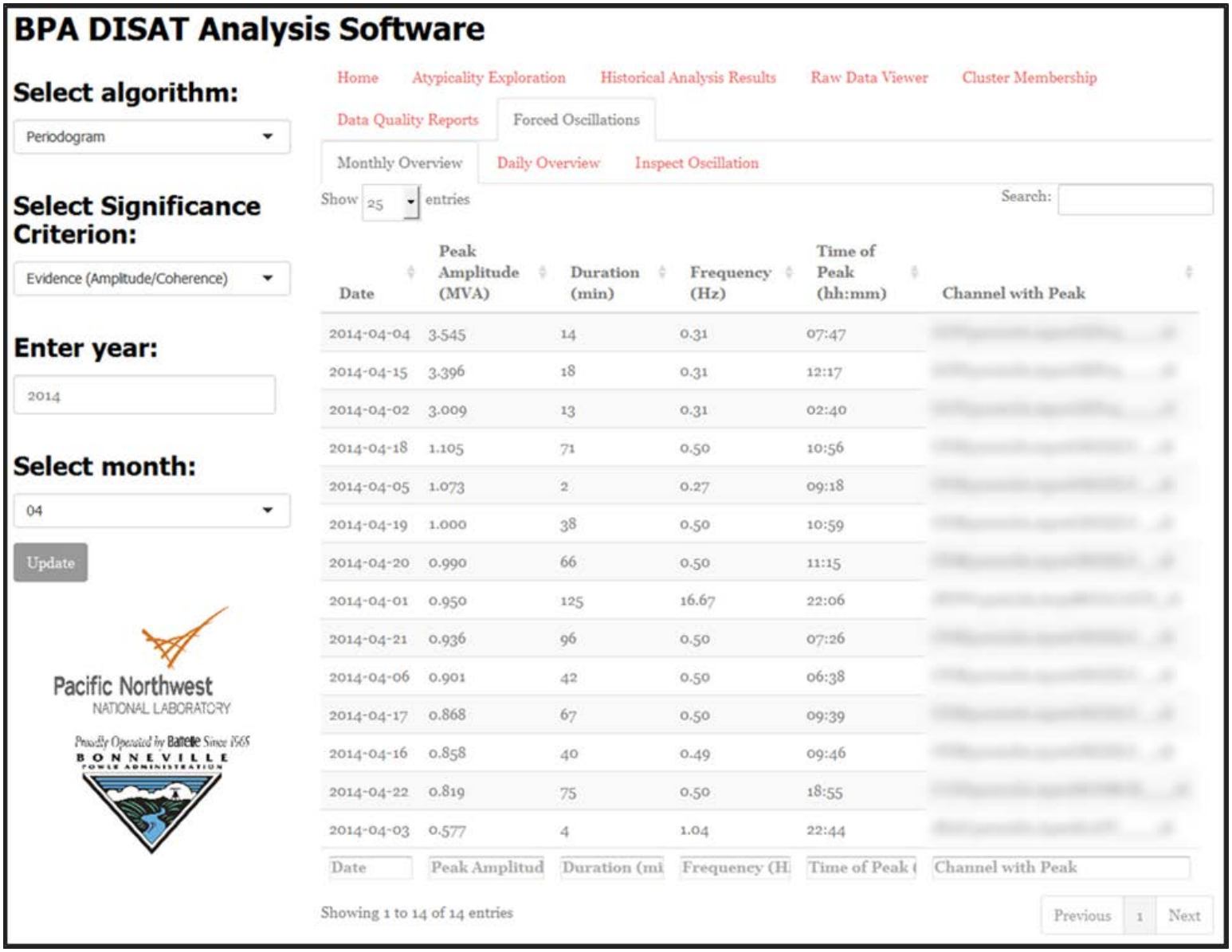

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BPA DISAT Analysis Software

Select algorithm:

Periodogram

Select Significance Criterion:

Evidence (Amplitude/Coherence)

Enter year:

2014

Select month:

04

Select day:

04

Update

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Show 25 entries Search:

Peak Amplitude (MVA)	Total Duration (min)	Frequency (Hz)	Time of Peak (hh:mm)	Channel with Peak
3.545	15	0.307	07:47	
0.959	545	0.497	11:41	
0.894	6	0.608	12:57	
0.411	84	0.667	14:09	
0.358	42	16.667	22:50	
0.296	36	0.835	00:12	
0.284	100	0.735	00:05	
0.204	78	1.500	23:04	
0.193	256	1.337	10:46	
0.185	6	2.485	17:04	
0.124	35	1.200	22:21	
0.104	110	2.400	13:48	
0.101	1192	3.972	17:42	
0.100	735	2.222	10:12	
0.098	4	2.942	05:30	
0.091	7	7.157	20:25	
0.090	1373	5.455	10:59	

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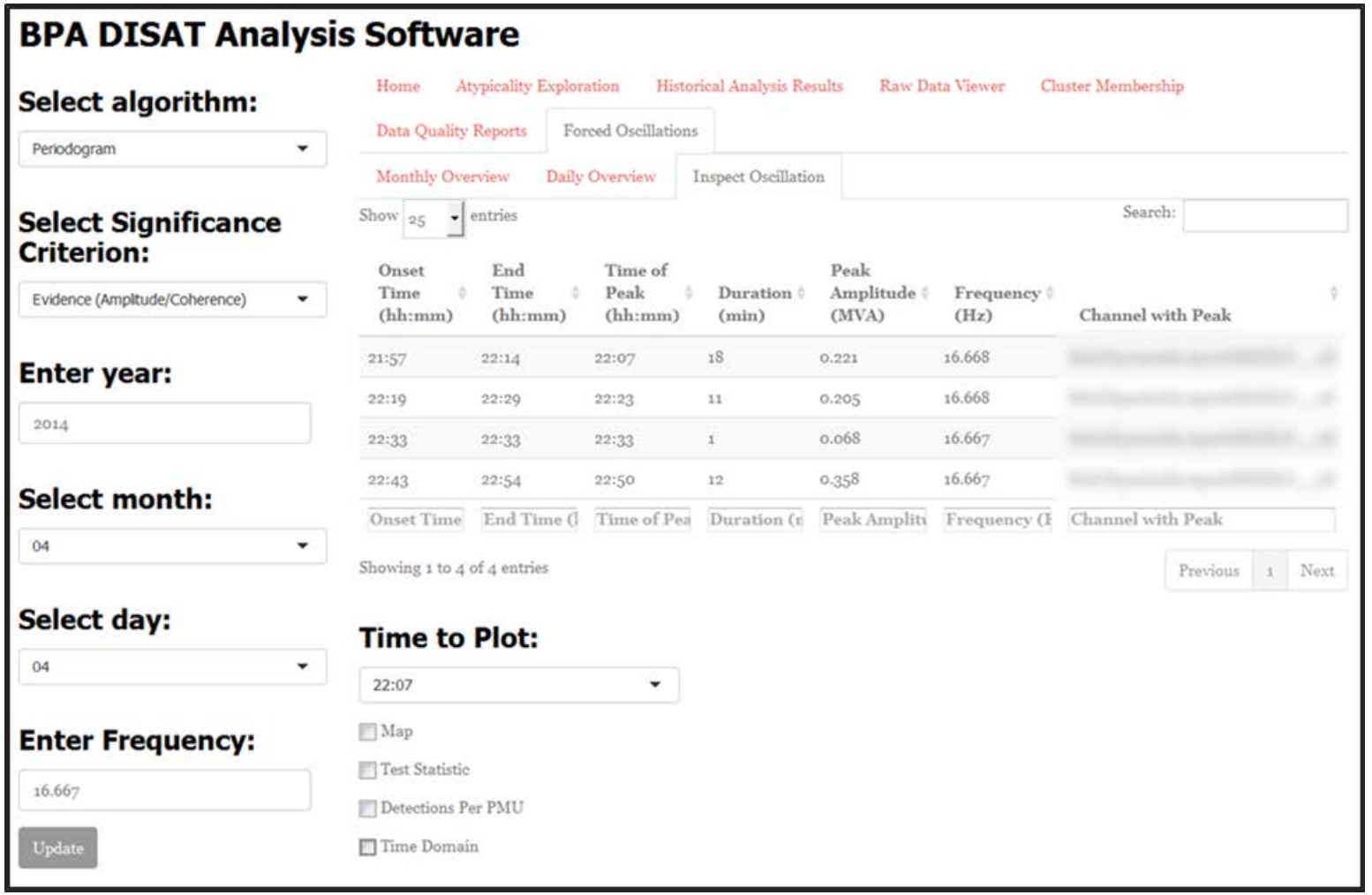

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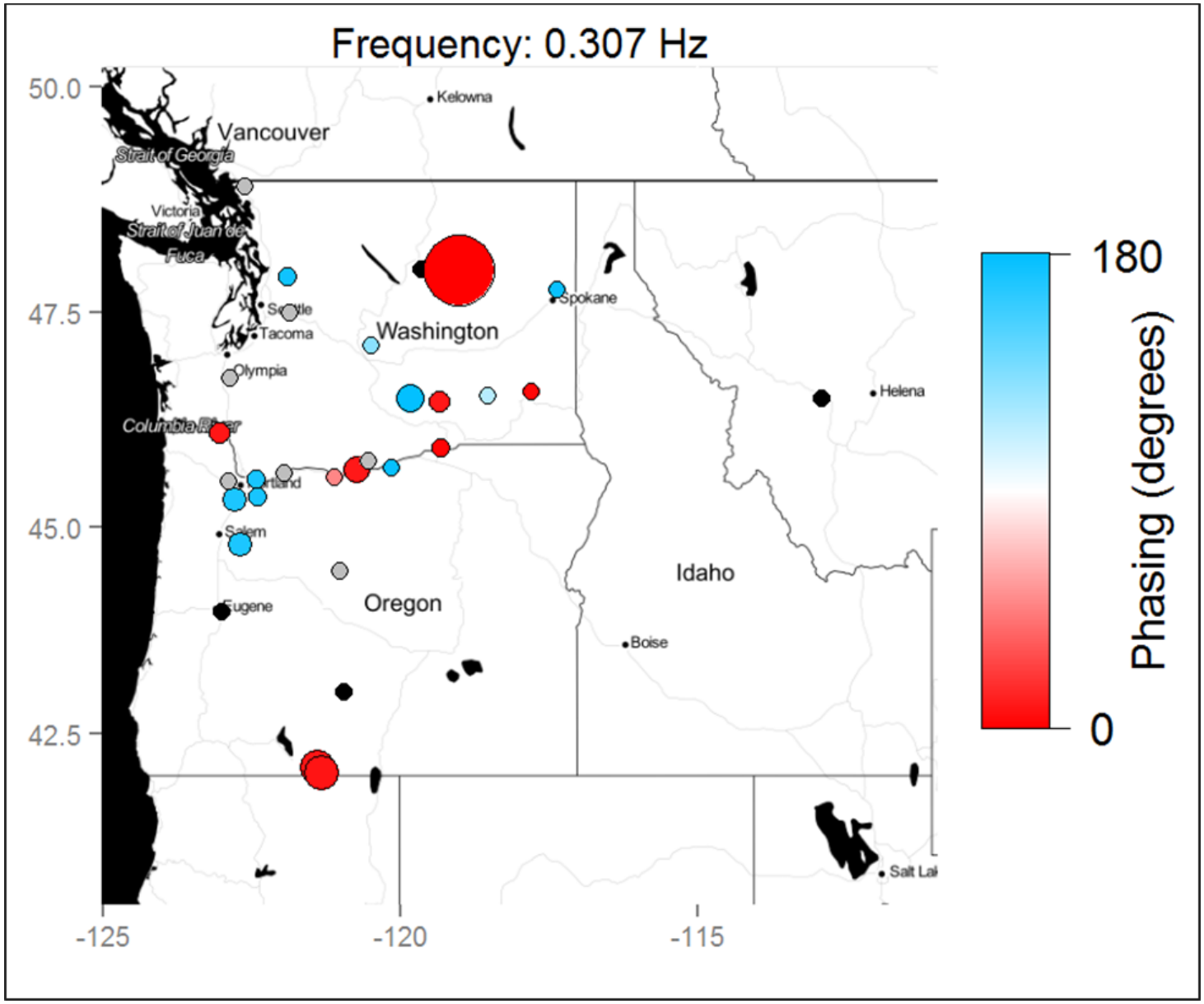

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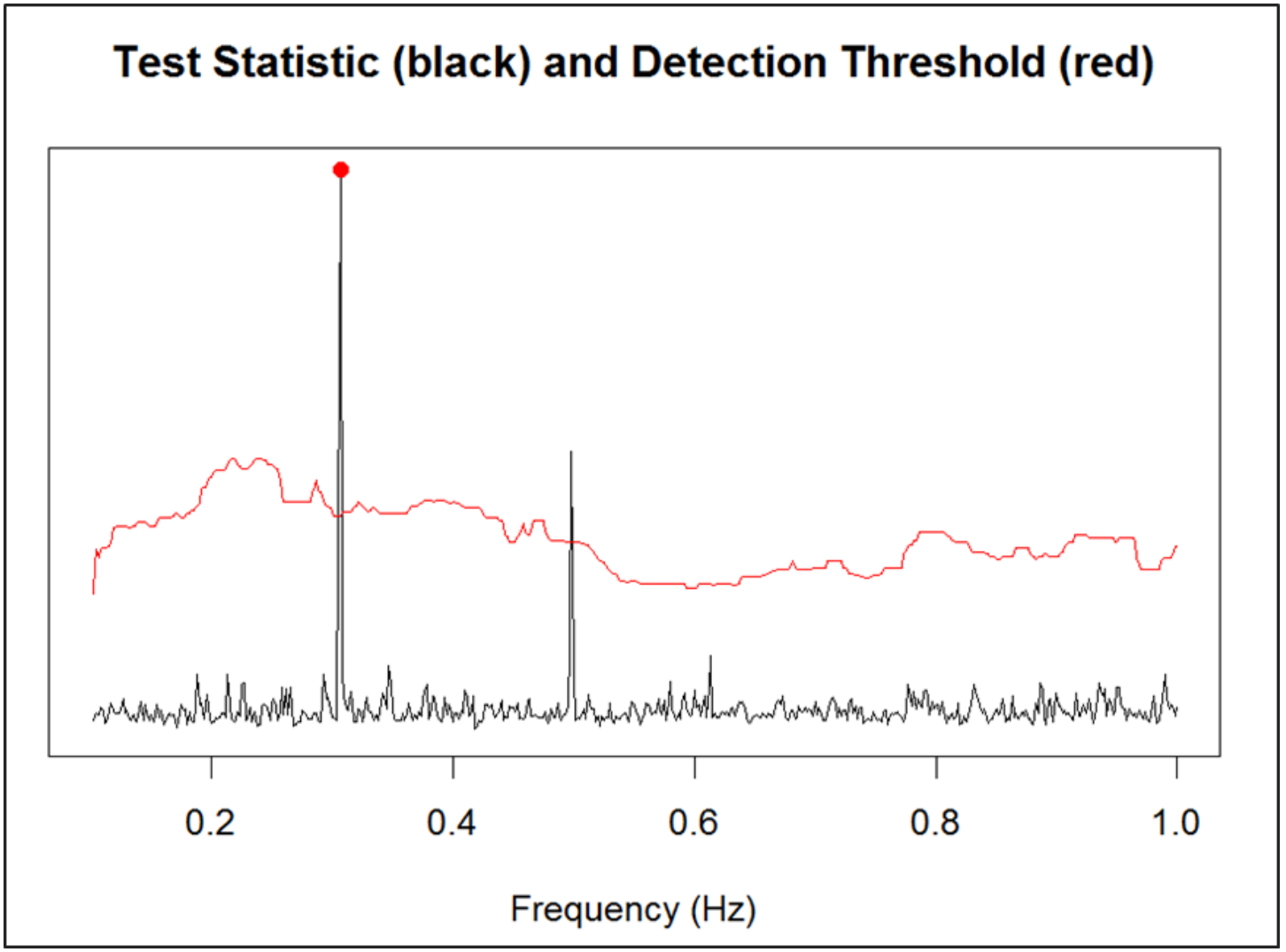
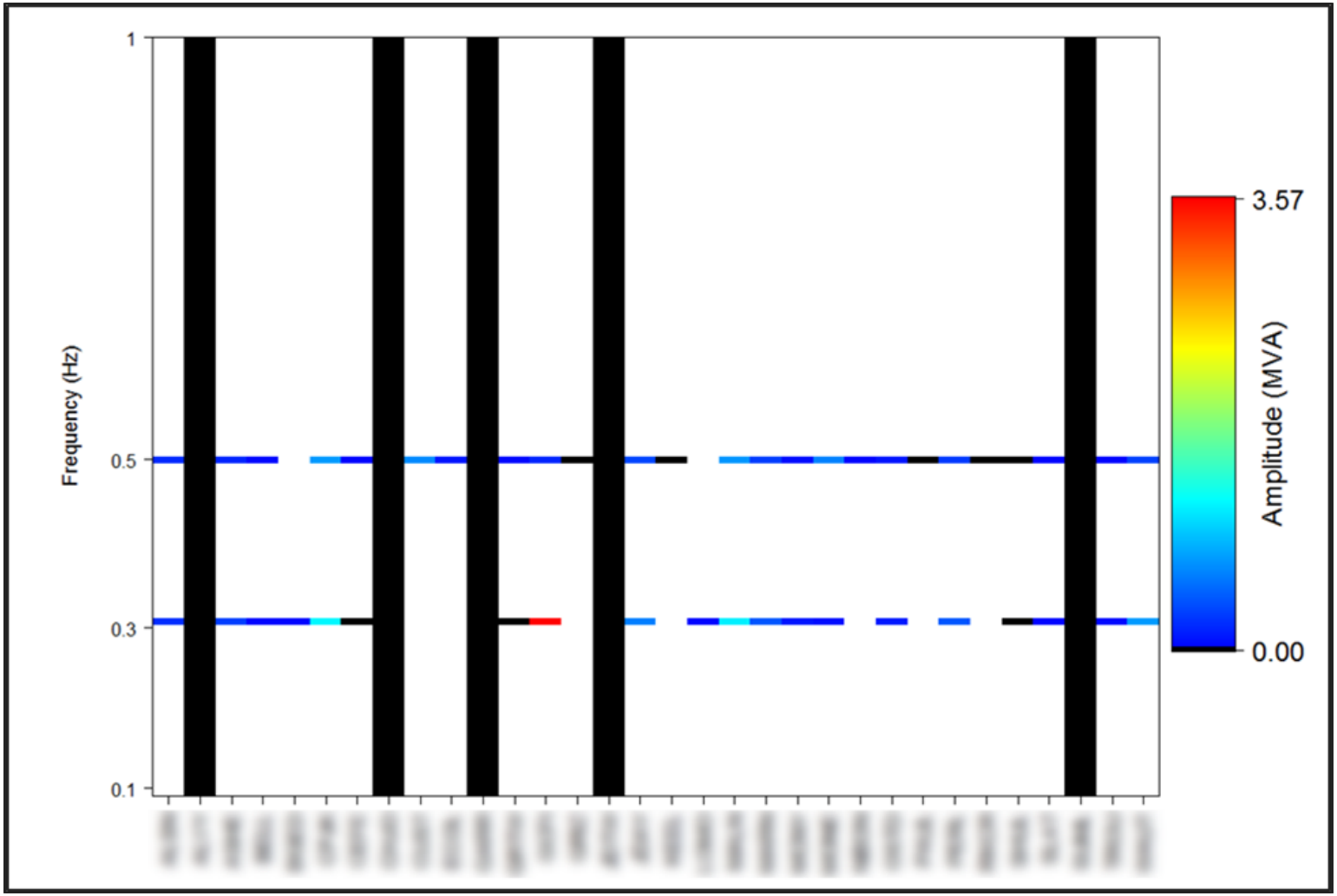

Test Statistic (black) and Detection Threshold (red)
0.2
0.4
0.6
0.8
1.0
Frequency (Hz)



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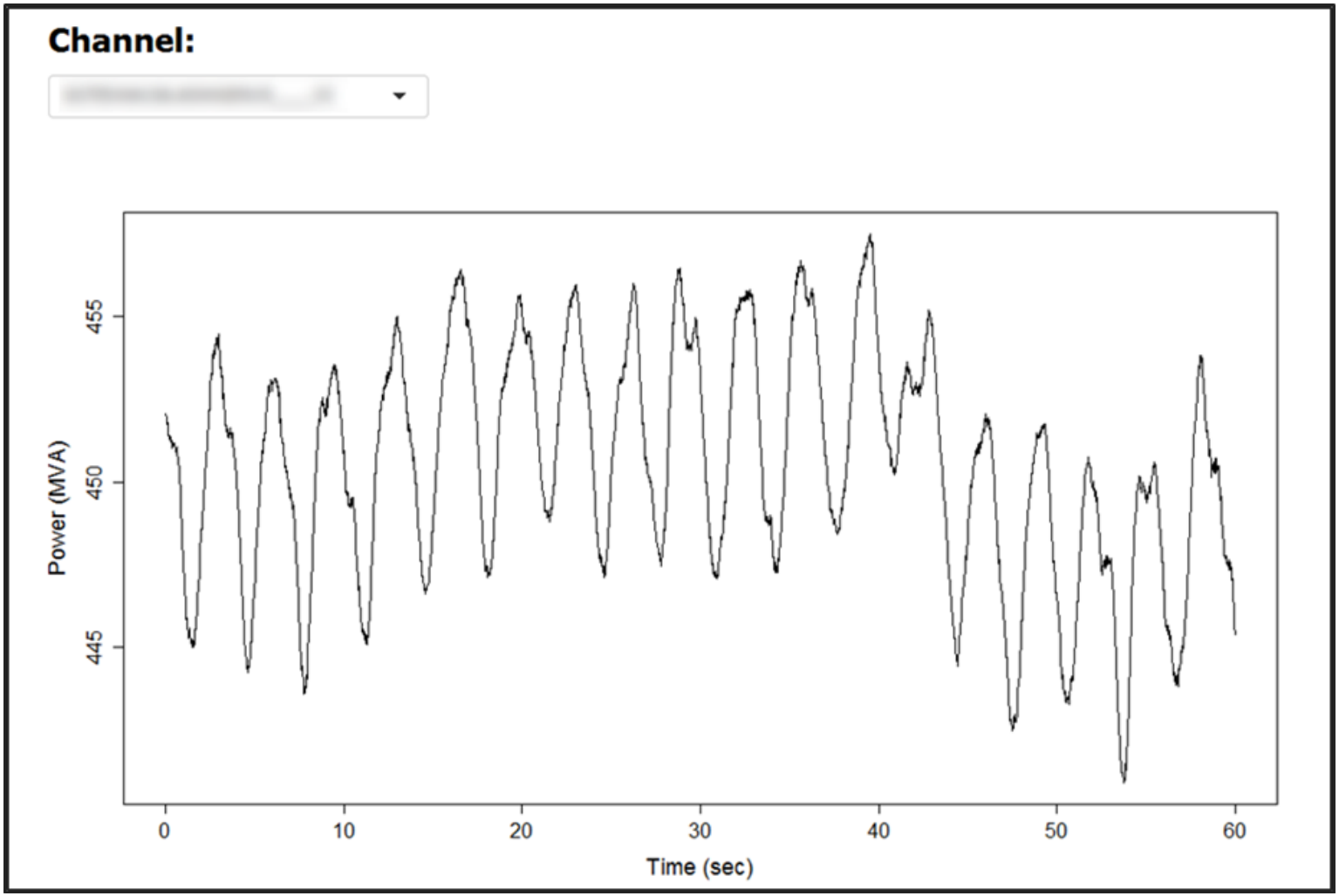

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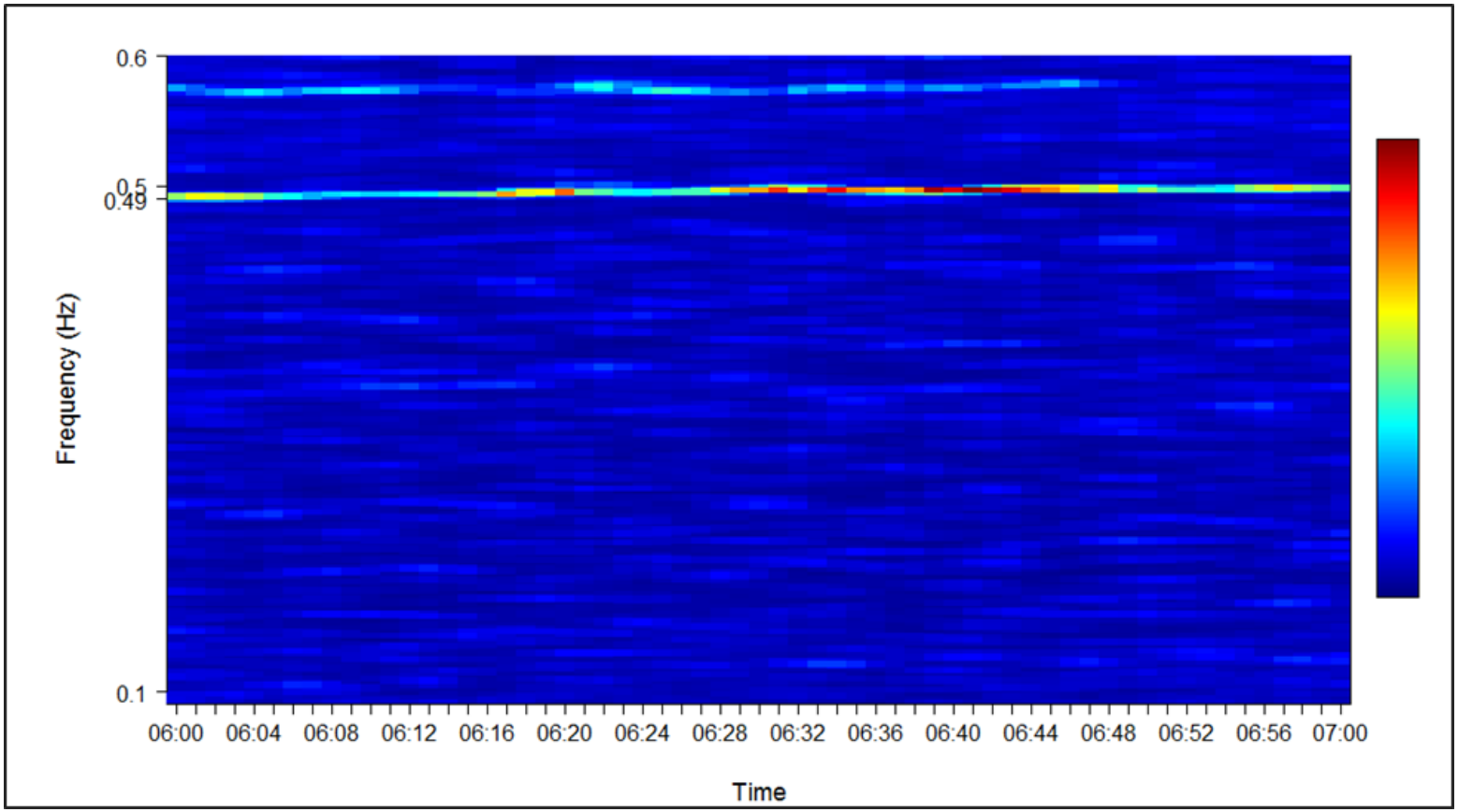

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Deliverables

- **Finish evaluation to expanded coherence and spectral methods**
  - Target: November 2015
  - Multi-channel Spectral-coherence and periodogram methods finalized
  - Improved detection performance demonstrated
- **Submit a journal/conference paper**
  - Target: December 2015
  - “A Multi-Channel Method for Detecting Periodic Forced Oscillations in Power Systems” was accepted to the 2016 IEEE Power & Energy Society General Meeting

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Deliverables

- **Refined DISAT implementation with expanded coherence and spectral methods incorporated deployed to BPA and interested entities**
  - Target: January 2016
  - DISAT upgrades installed at BPA's PMU laboratory January 28-29
- **Final Report containing updated methodology and results**
  - Target: March 2016
  - "Forced Oscillation Detection and Analysis with the DISAT Application" published March 2016
  - Report details DISAT implementation and user interface
- **With all deliverables met, no further activities are planned under FY15 funding**

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Project Continuation

- **Project is continuing in FY16 under GMLC Category 2 funding**
- **Suite of Open-Source Applications and Models for Advanced Synchrophasor Analysis**
  - Unifies many distinct analysis capabilities under a single framework
  - Allows for a common data pool and information sharing among applications
  - Major applications: power plant model validation, frequency response analysis, oscillation baseline application, load model data tool

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Project Continuation

- **Oscillation baseline application tasks**
  - Develop the oscillation baselining tool requirements (3 months)
  - Develop the oscillation baselining tool specifications (6 months)
  - Develop the prototype tool (9 months)
  - Deliver a prototype version of the baselining application for testing (12 months)
  - Coordinate project activities with industry-led efforts and working groups
- **Project is expected to start in the coming weeks**

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Questions?

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