



Oscillation Analysis Applications for Engineers – Pacific Northwest National Laboratory Tools

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NASPI Work Group Meeting
October 24, 2013

- ▶ Dynamic System Identification Toolbox
- ▶ Prony Ringdown GUI
- ▶ Spectral Coherence Analysis Tool

PNNL Oscillation Analysis Tools -- Overview


- ▶ PNNL-created tools are primarily MATLAB-based
 - Flexibility for algorithmic improvements
 - Prototyping for algorithmic proof of concept
- ▶ Tools are often developed as a path to algorithm/approach commercialization
- ▶ Some generic implementations of analysis types in commercial packages, but designed for adjustments and experimentation

- ▶ MATLAB-based collection of phasor measurement-oriented tools
- ▶ Data import/export functions
 - Import – SWX, PPSM, DST (BPA PDC formatted)
 - Incorporating COMTRADE format
 - Potentially incorporating PI Historian links
 - Export – DST+INI, MAT, CSV
- ▶ Data processing
 - Filtering, resampling, correction
- ▶ Data Analysis
 - Fourier-based techniques
 - Prony Ringdown GUI
 - ModeMeter tools – UWyo/MT Tech research

Dynamic System Identification Toolbox

Command Window

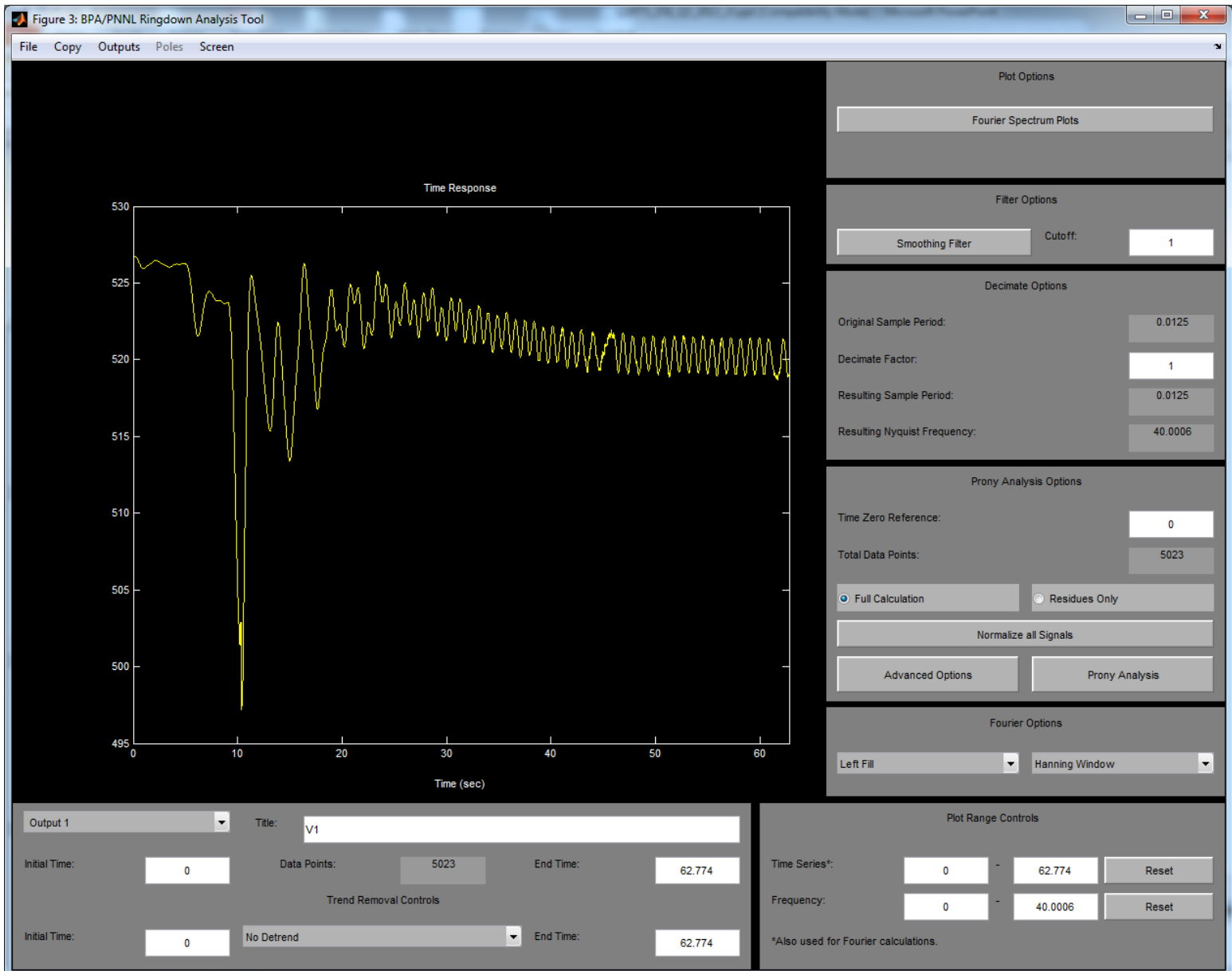
```
In Case Script PSMbrowser:
caseID = PSMbrowser
Select processing type: Options are
  1 Batch Plots
  2 Angle/Freq Refs
  3 Filter/Decimate
  4 Backload Filtered
  5 Fourier
  6 Histograms
  7 Ringdown GUI
  8 Ringdown Utilities
  9 AutoCorrelations
 20 ModeMeter GUI
 21 ModeMeter
 22 EventScan
 41 Phasor Utilities
 42 Backload Phasor Results
 51 Special Displays
 90 Macro (R)ecord
 91 Macro (P)lay (G)o
 92 Macro (S)top
 94 DownSelect Signals
 95 Load new data
 96 save results
 97 keyboard
 98 Defaults on/off
 99 end case
```

 Indicate processing type - enter number from list above [1]:

Prony Ringdown GUI

- ▶ MATLAB-based tool for analysis of ringdown events
- ▶ Prony-based algorithm
- ▶ Extracts modal information
 - Modal parameter estimates
 - Mode shape estimate
- ▶ Interactive analysis
 - Interval of analysis
 - Model order
 - Overlay of estimated modal content

Prony Ringdown GUI – Setup Screen



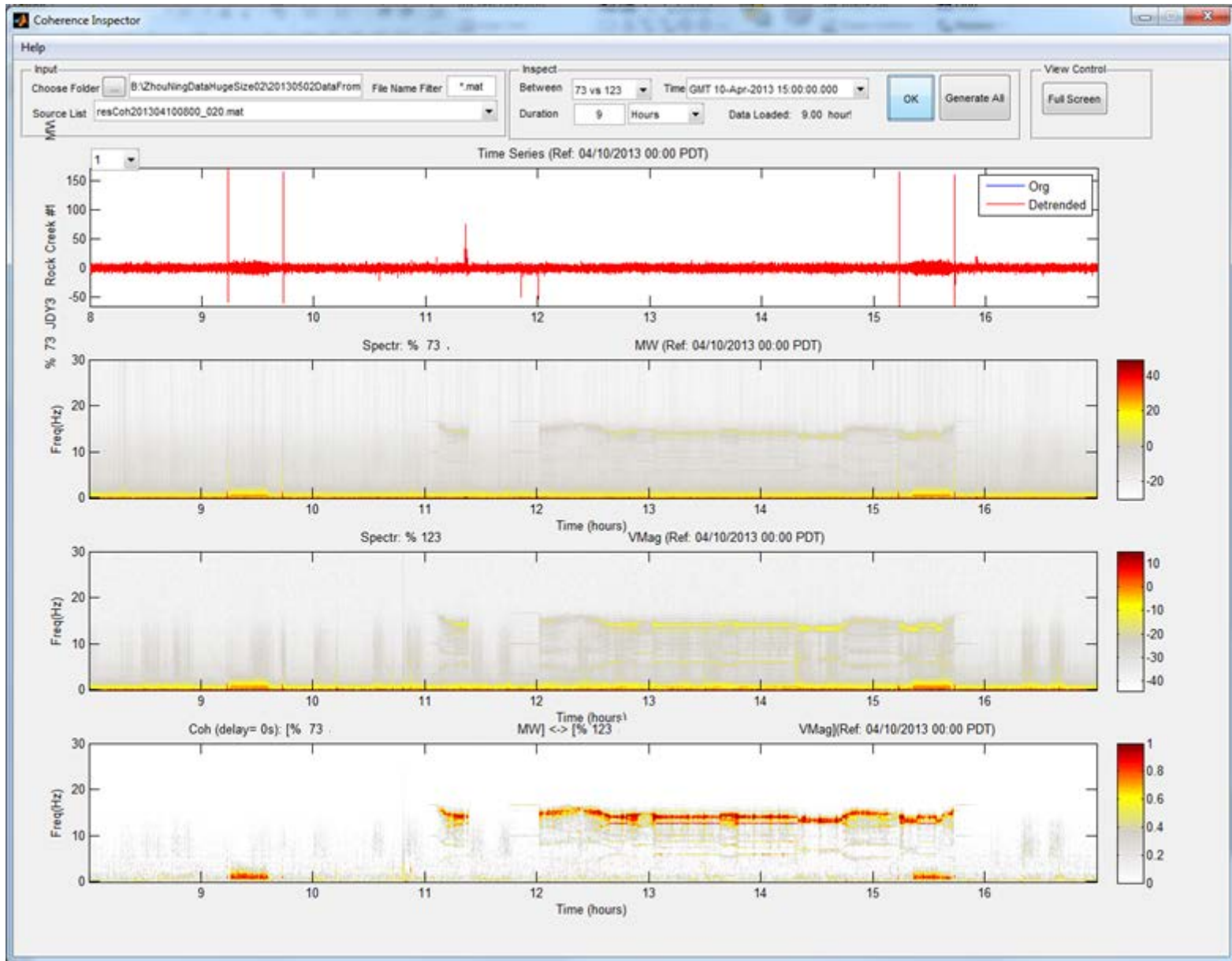
Prony Ringdown GUI – Results Screen



Spectral Coherence Analysis Tool

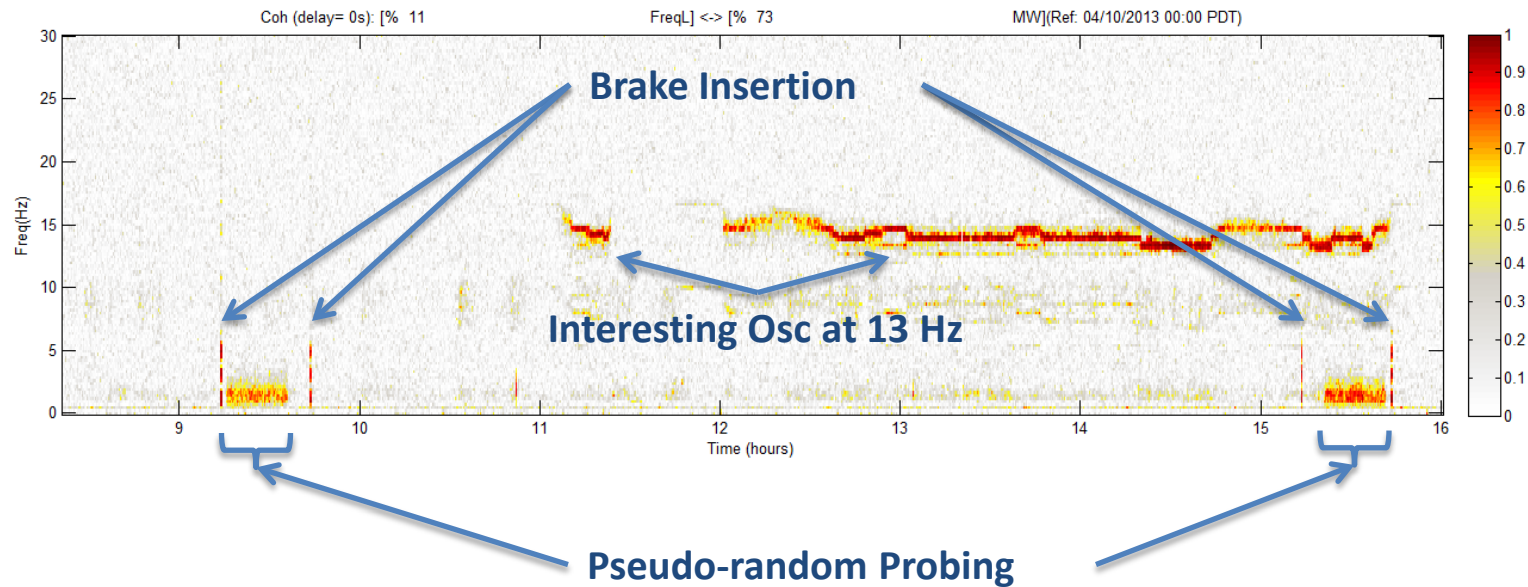
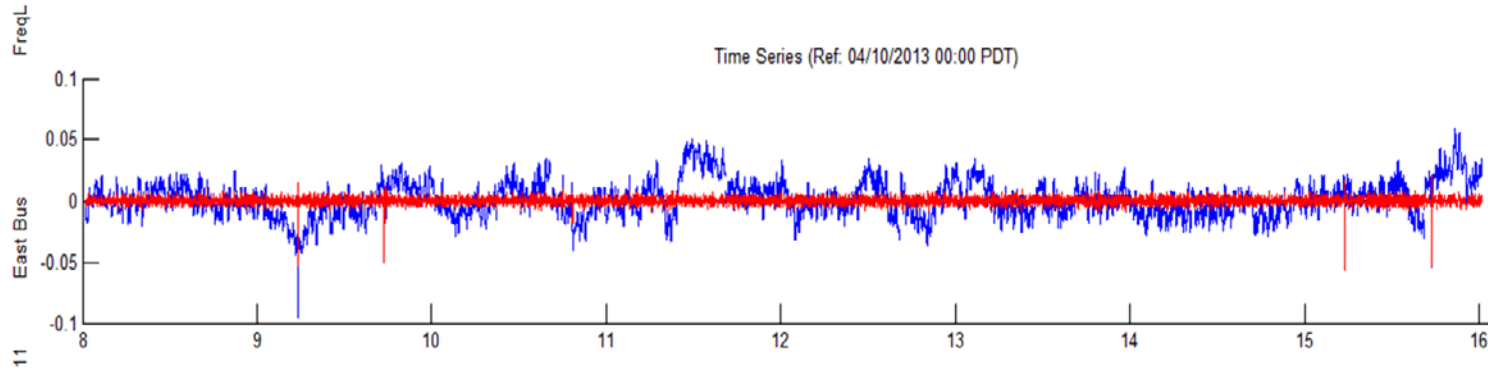
- ▶ MATLAB-based tool for detecting different oscillation types in data
- ▶ Primarily developed to detect sustained low-SNR oscillations in PMU data
- ▶ Periodogram-based analysis algorithm
- ▶ Useful to find:
 - Periodic oscillations
 - Forced responses
 - Ringdown events
 - Probing tests
- ▶ Ongoing development

Spectral Coherence Analysis Tool



Spectral Coherence Analysis Tool

April 2013 Probing Test



- ▶ Testing spectral coherence analysis tool
 - BPA deployment on historical and pseudo-realtime data
 - Offline analysis of previous events
- ▶ Refining sustained oscillation detection
 - Proper triggering and thresholding
 - Incorporation into commercial tool
- ▶ Investigate new methods or refinements for modal analysis