Discrete Component Detection and Analysis in the Stable32 Power Function

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Introduction

Stable32 Version 1.54 has a new capability to detect and analyze discrete spectral components (spurs) in its Power (power spectral density, PSD) function. This supports automatic spur detection for all the PSD types ($S_y(f)$, $S_\phi(f)$, $S_x(f)$ and $L(f)$), along with graphical representation of discrete spectral lines on PSD plots, identification of the largest spur in a plot message, and a table of all detected spurs written to the Windows clipboard.

Spur Detection

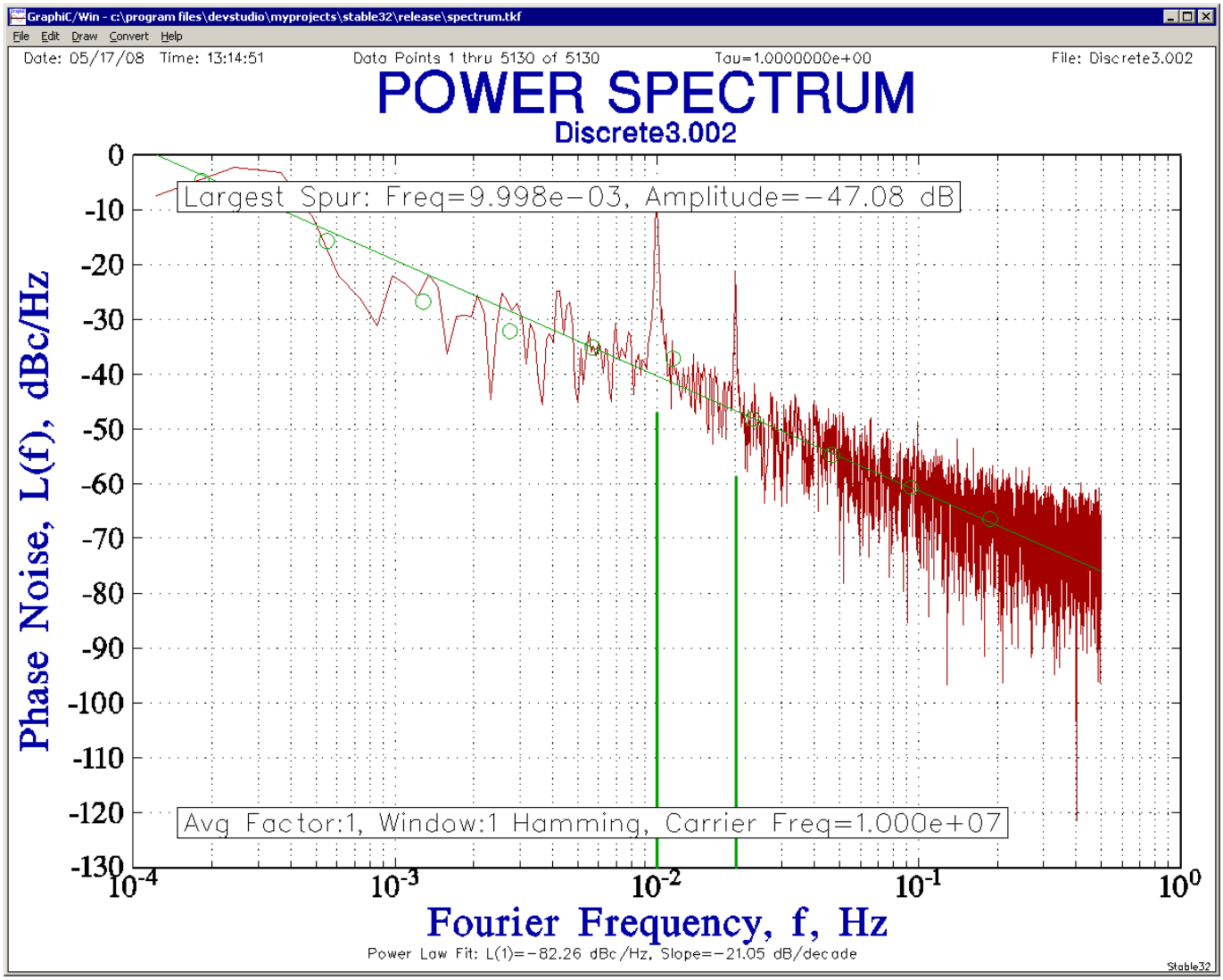
Spurs are detected by scanning the results of a PSD analysis and comparing the value in each spectral bin against an adjustable spur limit. That comparison is made after "prewhitening" the PSD results by subtracting a power law noise fit and thus removing its trend. The spur detection starts at the lowest unskipped Fourier bin and searches upward for a PSD value above the threshold. If a spur is found, the algorithm locates the bin with the local peak, and uses a parabolic fit to the adjacent points to determine a more exact value for the PSD value and Fourier frequency, and stores them and the center bin index in a spur array. The search process then moves off the peak and continues searching for additional spurs. Up to 100 spurs can be detected by this Stable32 spur detection algorithm.

Spur Analysis

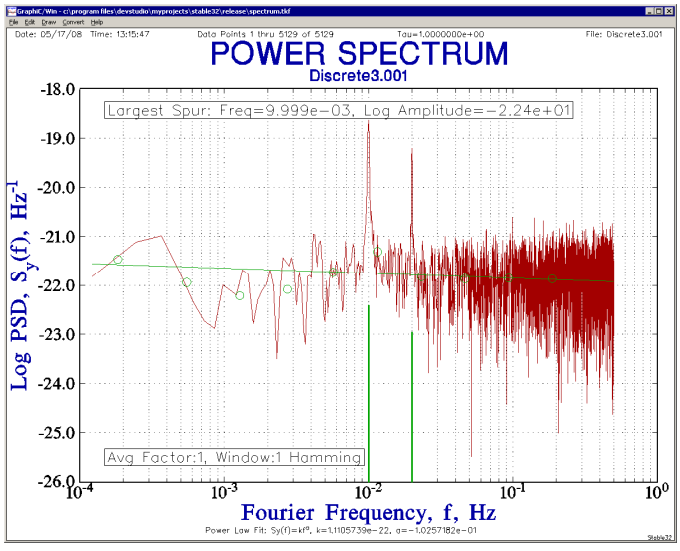
Three complementary means are used to present the results of the spur search, all under the control of options set in the Stable32 Power Spectrum Plot dialog box. The detected discrete spectral components can be shown as heavy vertical green lines on the PSD plot with their height indicating the spur amplitudes, which are corrected for their narrowband energy (e.g., shown as dBc rather than dBc/Hz). These lines extend from the bottom of the plot if the spur amplitude is below the power law noise fit, and from the noise fit if the amplitude is above it. Note that it is possible for the former to be completely off the plot scale. The number of spurs, and the amplitude and frequency of the largest spur can be shown in a message on the plot. In addition, a complete table of the spur number, FFT bin, Fourier frequency and log amplitude, along with other relevant information, is written as a text file to the Windows clipboard whenever spur detection is activated.

Examples

Examples of these new Stable32 spur detection and analysis features are shown in the figures below.



L(f) Plot with Spur Detection



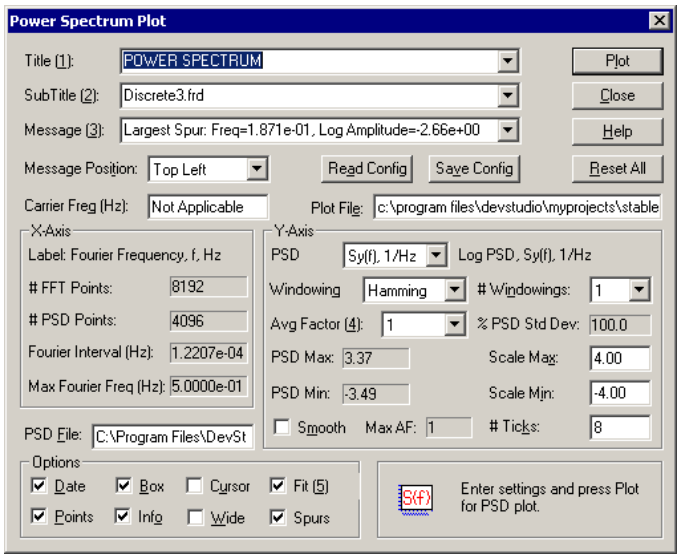
$S_y(f)$ PSD Plot with Spur Detection

```
File: Discrete3.001
PSD Type: Sy(f)
Log Spur Threshold = 2.000e+00 (x100.00)
ENBW = 1.664e-04 Hz, Log NB Corr = -3.78
PSD Discrete Spurs:
Spur   FFT    Spur          Discrete
       Bin    Frequency     Amplitude
#      #      Hz            Log df/f
1      81     9.999e-03     -2.24e+01
2      163    2.000e-02     -2.30e+01
```

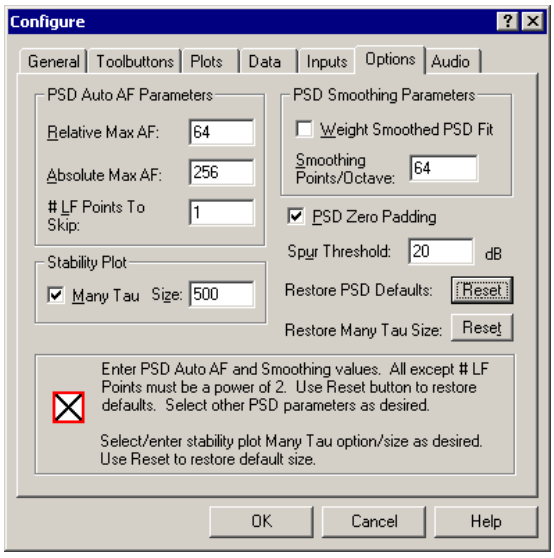
Clipboard Spur Analysis File

Options

The Stable32 spur detection and analysis options are set in the Power Spectrum Plot dialog box and the Options page of the Configure property sheet. Besides the normal PSD settings, the former contains a Spurs checkbox that activates spur detection. The spur plot message is controlled by a combination of this checkbox and the Message Position list box. The spur detection threshold (in dB above the power law noise fit) is set in the Spur Threshold in the latter. These controls are shown in the figures below.



Power Spectrum Plot Dialog Box



Options Property Sheet Page

File: Spur Detection in Stable32.doc
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