THIS APPLICATION CAN BE DONE USING:

PRODUCTS
- Block Diagram
- RIDE
- ImPro Lab
- VIDSP Studio
- VIDSP Suite
- OORVL Design Studio

Spectrum Averaging with Hypersignal RIDE

Overview

Spectrum averaging is performed for a variety of reasons in DSP and related engineering fields and is easily accomplished with Hypersignal RIDE. The averaging of a spectrum in time allows for the relative contribution of ambient noise to be effectively identified, and a noise characteristic obtained. Additionally, averaging may be used in a variety of recognition algorithms to identify background noise environments and distinguish certain sounds from other sounds. There exists several methods of achieving this averaging of a waveform and it need not apply purely to spectrum processing – virtually any signal which can benefit from a frame-based average can employ the following techniques.

Product Specific Information

This application will be implemented using Hypersignal RIDE. Hypersignal Block Diagram may also perform this averaging, but for real-time signals Hypersignal RIDE would be required.

Detailed Description

This application note will demonstrate averaging using three different techniques, using the Global Frame Mean function, the Power Spectrum function, and the Running Frame Combiner function.

Averaging using the Global Frame Mean Function

In this method, a frame-based running sum is calculated and divided by a running frame count, effectively giving the dynamic frame-based average over time. The output waveform, **y[m,n]**, is given as follows:

$$y[m,n] = (\Sigma x[m,n])/n$$

Where n = current frame index
m = sample index within frame
and the sum is performed over time in a frame-aligned fashion

Averaging using the Power Spectrum Function

The second will make use of the Power Spectrum function which employes an exponential filter in time for the averaging. The output waveform, **y[m,n]**, is given as follows:

$$y[m,n] = \alpha * y[m,n-1] + (1-\alpha) * x[m,0]$$

Where α = time constant (relative contribution of historical average)
n = current frame index
m = sample index within frame

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Averaging using the Running Frame Combiner Function

The final method will employ a Running Frame Combiner to calculate the average frame based on the current average and the current incoming frame. In this case, the average is given by:

$$y[m,n] = (y[m,n-1] + x[m,0])/2$$

Where n = current frame index
m = sample index within frame
and the quantities are added together in a frame-aligned fashion

Implementation

Averaging using the Global Frame Mean Function

In the Hypersignal RIDE application, as shown in Figure 1, spectrum averaging from a time-domain disk file can be accomplished (after performing an FFT and magnitude function) with **Global Frame Mean** block (found in **Statistical Functions** group) as follows:

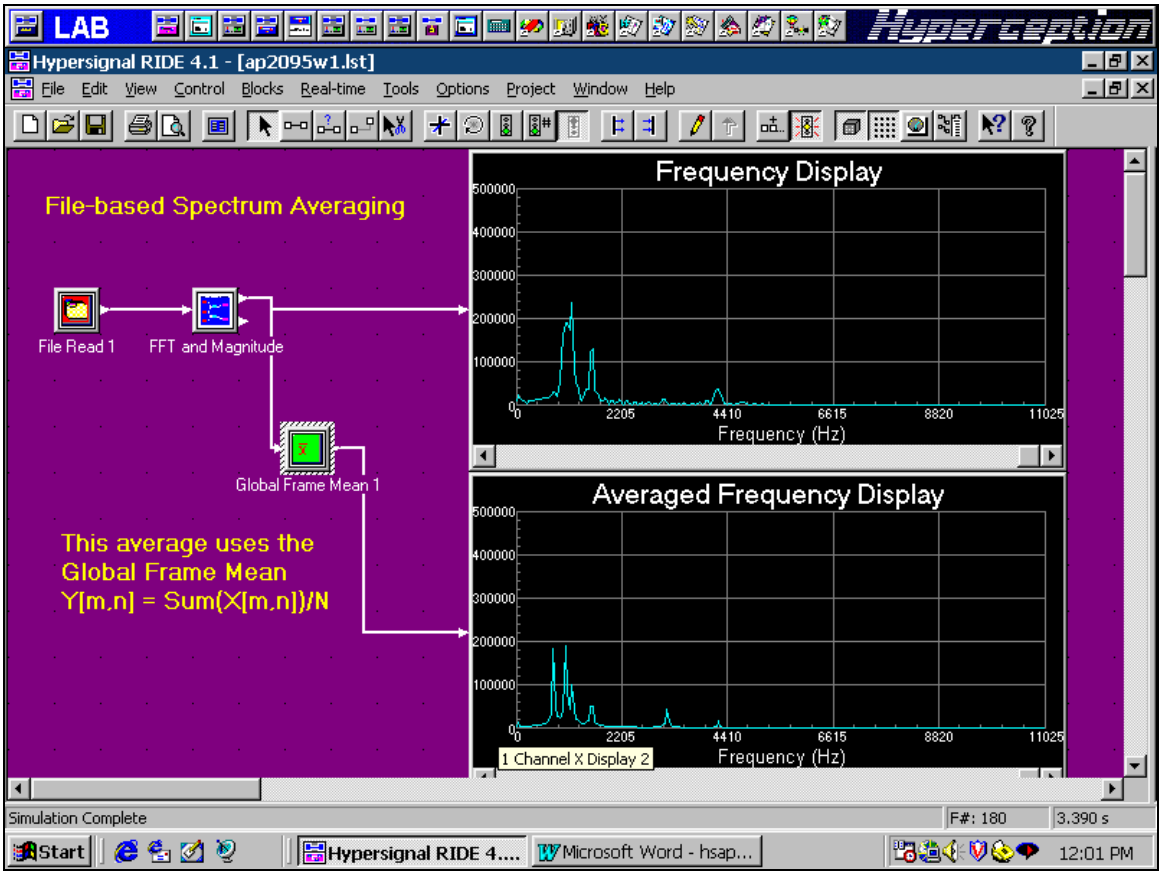

Figure 1 - Implementation of a frame-based average using Global Frame Mean in Hypersignal RIDE

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Averaging using the Global Frame Mean Function

In the Hypersignal RIDE application, as shown in Figure 2, frame-based averaging from a disk file can be accomplished using the **Power Spectrum** block (found in **DSP Functions** group) as follows:

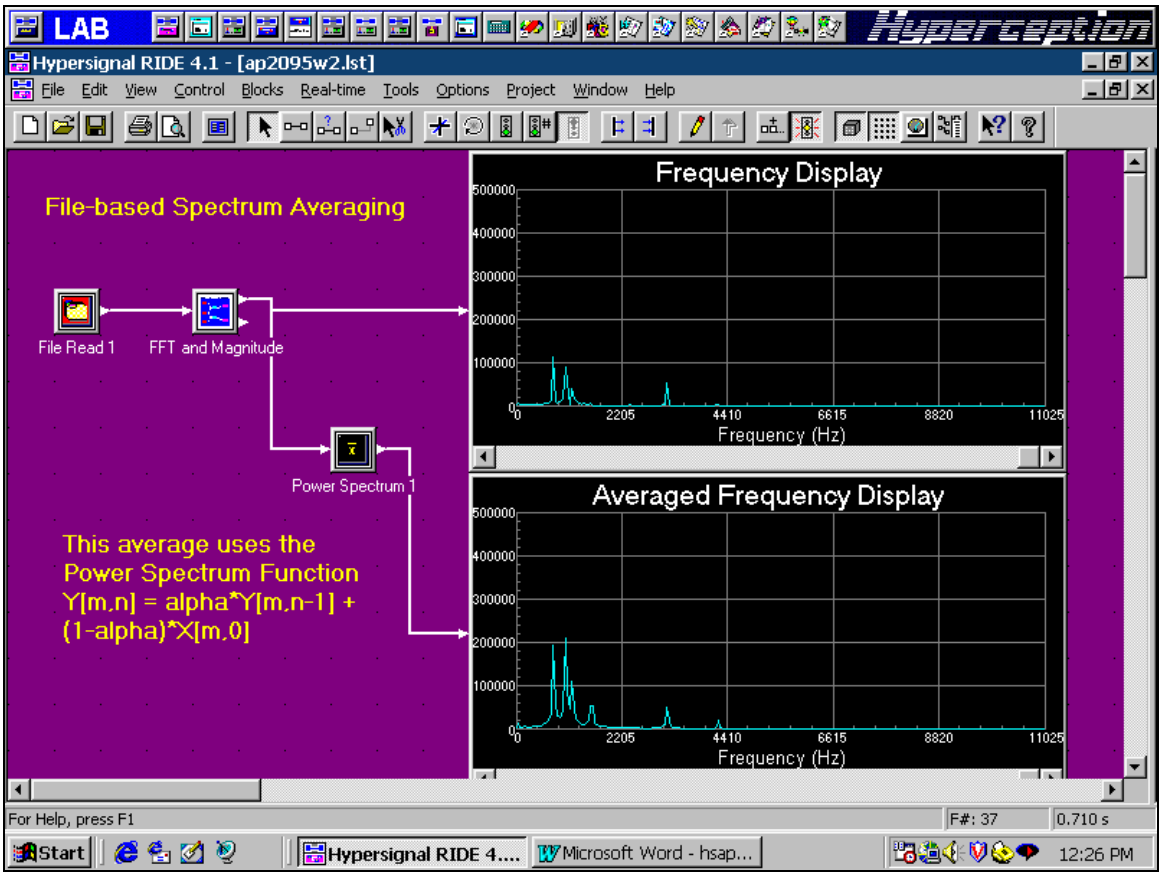

Figure 2 - The Implementation of frame-based averaging using Power Spectrum block in Hypersignal RIDE

Of course, the resulting averaged waveform may be used by any other block function, not just the displays as shown above. The resulting average could have been written to a disk file, or used along with any other displays or processing functions.

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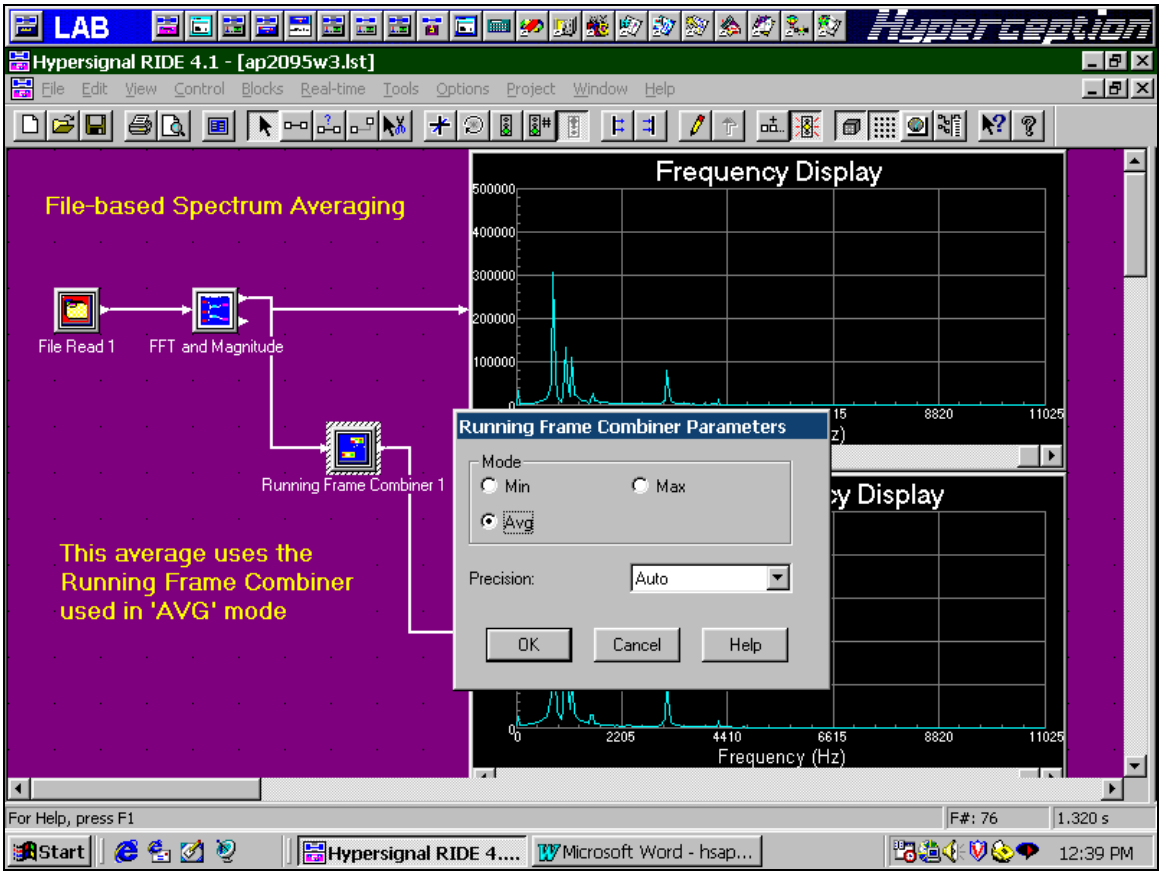
Averaging using the Running Frame Combiner Function

In the Hypersignal RIDE application, as shown in Figure 3, averaging from a disk file may also be accomplished using the **Running Frame Combiner** block (found in **Frame Functions** group) as follows:



Note that the contribution of the current frame is much greater using this approach as opposed to the first approach (using Global Frame Mean), and may also have more current frame contribution than the power spectrum method, depending upon the weighting factor used.

Applications

These three implementations of frame-based averaging demonstrate some of the power and flexibility of the Hypersignal RIDE and Block Diagram products. In addition to these three design methods, there are many other possible ways to accomplish averaging using these products, and virtually limitless possibilities exist using the standard block libraries; should the user wish, a cusom block function could also be created using the included Block Wizard tool and a windows compatible C compiler (i.e., Microsoft Visual C/C++).

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The successful designs may also be generated into ANSI C source code by using Hypersignal C source code generator, included in the **Enterprise Edition** of Hypersignal Block Diagram/RIDE. The resultant C source code can be cross-complied into the different DSP code and implemented in real time DSP hardware. The entire design has been conducted in the Hypersignal RIDE without the need for writing and debugging time-consuming simulation code required by the traditional methods.

References

None.

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