SystemView Times

Volume 1, Issue 1 *News of Interest to the SystemView Community* *October, 1995*

LEAD STORY

Windows '95 Released

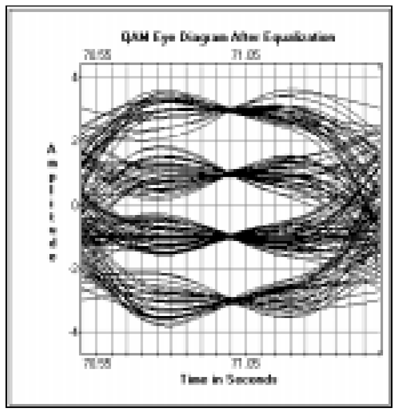
Microsoft Corporation's new operating system for the PC was finally released in August. While bringing true multitasking and 32 bit computing to the mass PC market, the Windows '95 OS is still compatible with applications designed to run on previous versions of Windows, according to Microsoft.

There is actually a difference between the shipped CD-ROM version and the diskette version of Windows '95, according to Windows Resources magazine. Evidently only the CD-ROM version contains the tools needed by network administrators to migrate client workstations from Windows 3.1x.

SystemView users considering a conversion to Win '95 will be pleased to find that the amount of system resources allocated to multiple open graphical windows (GDI) has been increased.

Under Win '95 users will find that they can open many more Sinks and calculated plot windows than was possible under Win 3.1x.

All current SystemView versions are fully compatible with Win '95.



Open your eyes to equalizers on p3.

The new 32 bit version of SystemView is scheduled for release in November of this year. Users who have purchased the Professional Maintenance program will be automatically upgraded at that time.

Please contact Elanix for more information about the new 32 bit upgrade for SystemView or the Professional Maintenance program.

USER NEWS

Auto Code Coming to SystemView

Elanix is currently developing the powerful new auto code option for SystemView. Beta release is scheduled for early spring.

The auto code option will allow SystemView users to automatically convert their system block diagram into C code simply by clicking the mouse, according to Geoffrey Chatfield, director of marketing at Elanix (*chatfield@elanix.com*).

Chatfield noted that the power of this feature really manifests itself for DSP engineers. "The conversion from a SystemView design to operational DSP code will be almost immediate and quite efficient from the designer's point of view," he stated.

Inside This Issue:

FIR Design Techniques Described

By Patrick J. Ready, Ph.D.
ELANIX, Inc.

SystemView has a built in FIR design capability that is both powerful and flexible.

Are you taking full advantage of all your SystemView FIR design tools? If not, please read on.

The Basic FIR

Basic FIR design is carried out in the Linear System window by selecting FIR under the Filters menu. After selecting the type of FIR (e.g., Low Pass, Band Pass, etc.) the FIR design template appears. At this point the basic design process begins.

The FIR transition width (from passband to stopband) is typically the most critical parameter. As you might expect, the narrower the transition width the more FIR taps (coefficients) are required to maintain the specified inband ripple and stop band attenuation.

The inband ripple specification and stopband attenuation also affect the required number of taps. Less ripple and more attenuation require more taps.

Therefore you should use combinations of transition width, stopband attenuation, and inband ripple to control the number of taps in your design.

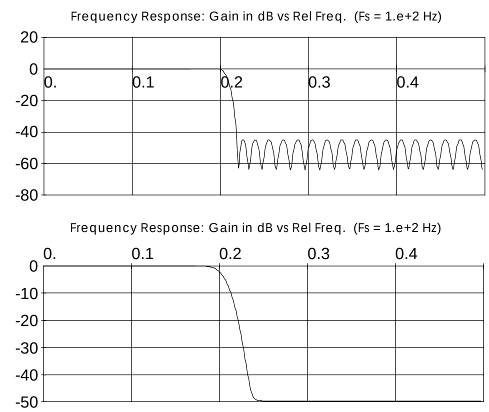
Be careful when using the transition width. If the transition width becomes too large, the constraint on the Parks-McClellan algorithm is not sufficient to control behavior within the transition region. You may see unusual ringing in the transition.

Using Time Windows to Improve Your Design

You've probably noticed the Window menu in the Linear System window, and discovered the Bartlett, Blackman, Hamming, Hanning, and Elanix windows listed there. How can you use these windows in your FIR filter design?

Here's how. First design a basic FIR as described earlier in this article. Click the Bode Plot button and zoom the FIR passband region to observe the inband ripple. Note the amplitude of the ripple.

FIR Filter Before and After Windowing



Now apply an Elanix window to the FIR. Return to the Bode plot and again examine the inband ripple. Its gone! Not only that, the stopband sidelobes are also gone!

Actually, the inband ripple and stopband sidelobes have been greatly attenuated. The reason for the attenuation is as follows.

Multiplying the FIR impulse response (the tap values) by a window is equivalent to convolving their frequency domain characteristics (Fourier transforms). The effect is to "filter" the gain response of the FIR with a lowpass filter. The "high frequency" ripple and sidelobes are smoothed and therefore attenuated.

The price paid for ripple and sidelobe reduction is increased transition width between passband and stopband. Just as windowing smoothes the ripple it also smoothes the transition band, making it wider.

Using The Sin(t)/t Filter

The Sin(t)/t filter (found in the list you see when you select FIR under the Filters menu) is unique in that it has the theoretically narrowest transition region. However, it also has very poor stopband attenuation.

Combining the Sin(t)/t filter with the appropriate window can yield very good FIR designs. The idea is to create narrow transitions with good stopband attenuation.

Select Truncated Sin(t)/t from the FIR list and specify the desired specifications. Next apply a time window. Your window selection will determine the stopband attenuation. The Blackman and Elanix windows will give the best attenuation.

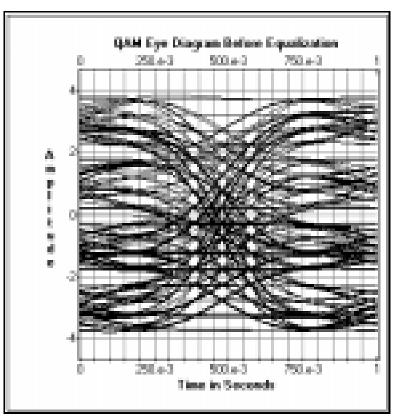
Dr. Ready can be reached at:
1.818.597.1414
ready@elanix.com

Modeling Equalizers

By Joseph Zablotney, Ph.D.
MRJ Incorporated

Equalizers are essential in removing channel distortion in modern digital communications systems. This distortion is typically due to a combination of bandlimiting at the transmitter and multipath in the channel. In linear systems these distortions can be modeled as either an infinite impulse or a finite impulse response filter. The purpose of the equalizer, then, is to approximate the response of a filter matched to the inverse of the channel response. Typically, the manifestation of this response is a FIR filter.

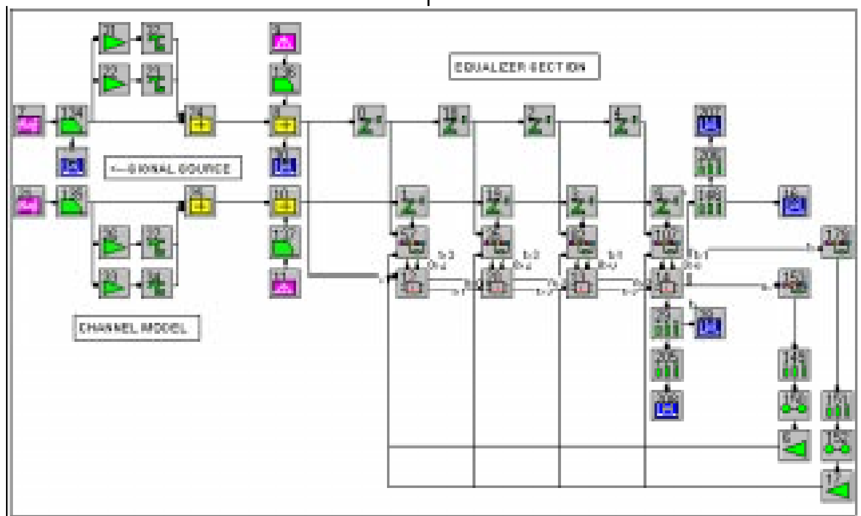
In many existing systems, the principal method for determining the coefficients of the inverse filter is to use a training signal transmitted prior to data transmission. The disadvantage of this method is that as channel conditions change, the performance of the equalizer will deteriorate. Therefore adaptive



equalization techniques have found increasing use in modern digital communications systems.

SystemView provides an ideal tool for analyzing equalizer performance.

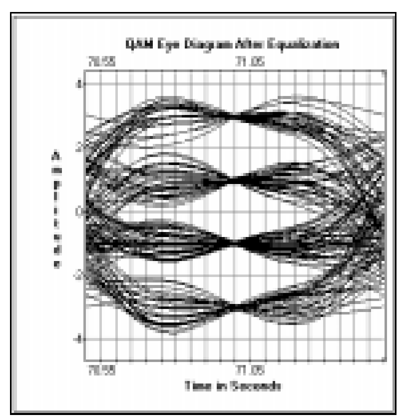
Both simple and adaptive structures can be modeled very quickly in contrast to modeling in a foundation language and the



inevitable debugging associated with that process. An example of the modeling power of SystemView is illustrated by the above system -- a five stage adaptive equalizer. This simulation models a least mean squares (LMS) adaptive equalizer modified by the Sato algorithm. The simulation represents a complex baseband process (both I and Q components are required). This equalizer uses the Widrow-Hopf method for coefficient update when the error is less the 1/2 the distance to the nearest constellation member, otherwise it uses the Sato update technique. The latter uses a reference point at the "center of gravity" of the first quadrant of the constellation.

The SystemView simulation consists of three basic sections. The first generates the baseband I and Q signal components which represent either a 4 QAM or 16 QAM signal. The signal is band limited by a 7 pole, linear-phase IIR filter. The second is the channel model which, in this case, contains a simple multipath delay. The power in the channel is normalized to unity at the input to the equalizer section.

The SystemView architecture of the equalizer is a five tap, Δt spaced (one symbol delay) structure. This type of visualization is one of the benefits of the SystemView implementation paradigm. Each tap has an associated MetaSystem, as shown above, in which the equalizer weights are updated once per symbol interval and the contribution to the equalizer output is calculated.



An additional delay, located in the weight update portion of the MetaSystem, is included to account for proper sampling of the equalizer output at the opening of the "eye". A second MetaSystem is used to update the error used to adaptively adjust the equalizer's coefficients, again once per symbol. The parameter defined by the gain in the feedback loop directly after the error calculation is important to ensure the stability of the equalizer while minimizing the time to convergence of the coefficients. Typically a value less than .1 guarantees stability. A value of .02 is picked as a compromise.

Ideally, the performance of the equalizer is measured through a symbol error rate calculation. To collect the amount of data needed to accurately determine these numbers takes time. Fortunately, a considerable amount of qualitative performance data can be obtained by examining "eye" patterns and constellation maps at the output of the simulation. The eye patterns are easily generated as time sliced diagrams of the data. The time slice is set as an integer multiple of the symbol interval. In the figures shown, the interval is one symbol. I recommend that data later than about 50 symbols be used to allow the equalizer to reach steady state operation.

A more quantitative measure of performance is cluster variance. This variance is defined as the least mean squares average of the distance between a measured constellation point and the correct constellation point with which is associated. The variance is a measure of the spread of the measured points around the correct constellation members. It assumes that this distribution is identical for each point. A comparison of the SystemView derived cluster variance and the associated theoretical value indicates that this is a useful measure. Once in possession of these values, bit error rates can be reasonably approximated.

The basic equalizer structure described above applies to many other equalizer types. Constant modulus and decision feedback designs have also been modeled. The strength of SystemView modeling is apparent when one realizes that these models require only simple changes to the weight and error MetaSystems.

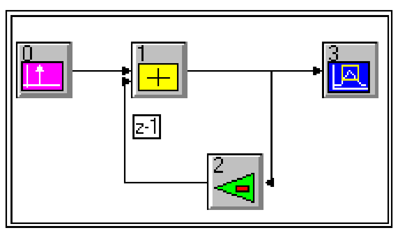
Dr. Joe Zablotney is responsible for the development of advanced communications and signal processing systems at MRJ, Inc. He can be reached at 703.277.1223.

The above system, "equal_iq.svu" is available on-line from Elanix at:

BBS: 818.597.0306
URL: http://www.elanix.com

Inside SystemView

What are those small green z^{-1} boxes that appear from time to time in my SystemView block diagram? How do they affect my system?



The small "z box" indicates a one sample delay, called an implicit delay, that really does exist in your system. The delay is displayed by SystemView to remind you that the delay is there.

Why is the delay necessary? Because Mother Nature won't have it any other way--there are always delays in feedback paths.

In the simple system shown, the Adder token produces the sum of its two inputs. But the input from the feedback Gain token is the output of the Adder. The Adder can't compute its output until it knows its inputs, but it can't know its inputs until it computes its output.

The Gain token output must be delayed by one sample (z^{-1}) in order to resolve the above syndrome.

For analog systems the effect of the implicit delay is negligible if the delay is small relative to 1/system bandwidth. Phrasing it another way, the implicit delay is negligible if your system sample rate is "large" relative to the system bandwidth.

For digital systems the delay should be carefully considered. For example an IIR filter explicitly built with tokens must include the implicit delay. A feedback path in the IIR that requires an *N*-sample delay should use a Sample Delay token having an *N-1* sample delay.

For a more extensive explanation of implicit delays see Chapter 13 in the SystemView User Guide. In the same chapter you'll also find a good discussion of algebraic loops and how to make them stable.

Comm Library Enhancements

The Bit to Symbol and Symbol to Bit tokens have been improved in the latest SystemView release, version 1.8-4.

The enhanced tokens simplify the implementation of a BER calculation by reducing the total number of tokens required. The enhanced tokens are also conceptually more straightforward and speed up system simulation time.

Calendar of Events

■ **Digital Communications and Spread Spectrum Systems:**
A one day short course

Date: Wednesday, 10/31/95
Time: 9:00 a.m. to 4:00 p.m.
Location: Irvine Marriot, Irvine, CA

Gain a practical understanding of the theories and techniques for building modern digital communications and spread spectrum systems. Emphasis will be on the whys, hows and performance measures of modern communications systems.

Who should attend? Engineers, managers and other professionals who desire a working knowledge of the topics covered.

Prerequisite: General engineering background.

Digital Communications topics:

- Optimum receiver principles
- MPSK, FSK, MSK modulations
- BER performance
- Matched filters

Spread Spectrum system topics:

- Max length, Gold, Kasami codes
- Processing gain
- Applications: Multipath, interference and more
- Synchronization

Lecturer: Maurice L. Schiff, Ph.D, V.P., Advanced Systems, ELANIX, Inc. Dr. Schiff has over 25 years industrial experience in digital communications and spread spectrum systems. He has worked on major systems including SINGCARS, GPS and JTIDS.

Fee: $350

For more information or to enroll, contact Elanix at 818.597.1414.

■ **Regional SystemView Demonstration/Hospitality Suite**

Date: Tuesday, 11/7/95
Time: 10:00 a.m. to 4:00 p.m.
Location: Sheraton Harbor Island Hotel, San Diego

On November 7, 1995 Elanix will host a hospitality suite that coincides with the MILCOM '95 trade show in San Diego, California. SystemView product demonstrations are scheduled throughout the day. *Sign up in advance for a chance to win the SystemView Professional Edition!*

The hospitality suite is open to the public. MILCOM registration is not required to attend the SystemView demonstration.

Dr. Maurice Schiff, V.P., Advanced Systems for ELANIX will be on hand to provide technical demonstrations and answer your questions regarding DSP and Communications applications.

Contact Elanix at 818.597.1414 for more information or to register.

RF/Analog Library now Available

Elanix has recently released a powerful new optional library for RF/Analog applications. The SystemView RF/Analog Library supports the important electronic components used in today's RF designs.

For the first time, SystemView users will be able to incorporate actual analog circuits and components into their system simulations.

For example, RF mixers and amplifiers actually create the spurious frequency components that engineers will encounter during final hardware development.

This library includes models such as fixed and variable amplifiers, double balanced mixers, many power splitter and power combiner types, couplers, diodes (including Zener diodes), resistor-capacitor differentiators, resistor-inductors, low-pass and high-pass R-C and L-C filters, PLL filters, LC tank and quadrature circuits, coupled resonator pairs, and more.

For further information or to order the SystemView RF/Analog library, contact Elanix sales at 818.597.1414 .

$100 Award!

Elanix is actively promoting and sponsoring the exchange of techniques and useful technical information throughout the SystemView user community.

We are offering a $100 author's award for articles contributed by SystemView users and published in the SystemView Times.

Articles can discuss any topic of interest to the SystemView user community. Send your articles to the Editor at the address below.

SystemView Times
5655 Lindero Canyon, Suite 721
Westlake Village, CA 91362
Tel: 818.597.1414
Fax: 818.597.1427
E-mail: systemview@elanix.com
URL: http://www.elanix.com
BBS: 818.597.0306

SystemView Sales Information

If you're interested in further information about any of our products or would like to obtain an evaluation version of SystemView, please contact:

ELANIX, Inc.
5655 Lindero Canyon Road,
Suite 721
Westlake Village, CA 91362
Phone: 818.597.1414
Fax: 818.597.1427
BBS: 818.597.0306
e-mail: elanix@elanix.com

International Distributors:

Europe
EnTegra Limited
2 Waltham Road, Maidenhead,
Berkshire SL6 3NH, U.K.
Phone: 44.01.628.829.061
Fax: 44.01.628.824.790

Japan
Nepco, Incorporated
U.S. Office
23552 Commerce Center Drive,
Suite L
Laguna Hills, CA 92653
Phone: 714.837.3328
Fax: 714.837.3119
Tokyo Office
3-26-6-609 Aoto, Katsushika-ku
Tokyo, Japan 125
Phone: 03.3690.7424

Korea
Echo Microsystems
Suite 105, Kangbyeon Hanshin
Core Officitel, 350
Mapo-Dong, Mapo-Ku, Seoul,
Korea
Phone: 82.2.704.5378
Fax: 82.2.704.5379
e-mail: echowon@nuri.net

Africa
Mission Electronic Systems
P.O. Box 3187
Benoni, 1500
South Africa
Phone/Fax: 27.157.59944
or 27.157.59721
e-mail: 100076.1014@
compuserve.com

Reader Service Card

Please assist us in keeping our mailing list up to date by providing modifications or additions to your address and phone number in the space below. You can fax this form to us at 818.597.1427 or mail it to the address listed above.

Name: ____________________

Title: ____________________

Company: ____________________

Address: ____________________

____

City, State: ____________________

Zip Code, Country: ____________________

Phone: ____________________

Fax: ____________________

E-mail: ____________________

❑ Please register me for a free subscription to the SystemView Times.

❑ Please have an applications engineer call me.

❑ Please remove me from your mailing list.

Please send me information on:

❑ SystemView Professional Edition

❑ SystemView Communications Library

❑ SystemView DSP Library

❑ SystemView Logic Library

❑ SystemView RF/Analog Library

❑ SystemView User Code Option (Create your own custom tokens!)

❑ SystemView Auto-Code Option

ELANIX INCORPORATED
5655 Lindero Canyon Road, Suite 721, Westlake Village, CA 91362
Tel +1 818 597-1414 Fax +1 818 597-1427 BBS +1 818 597-0306
e-mail systemview@elanix.com URL http://www.elanix.com

SystemView Times is a quarterly publication of ELANIX, Inc.