soundInnovations: the manufacturer's view

A Better Way to Drive

Electro-Voice FIR-Drive

by Ethan Wetzell

Electro-Voice has recently launched a program we refer to as FIR-Drive. As I discuss this with folks and the FIR-Drive logo pops up more and more, the questions come up "What is it? Is it a thing? When do I get one?" Great questions—ones I hope to answer here.

To get to the answer, we first need to step back and look at what we, as audio professionals, design and operate to make our livings—namely, audio systems. That's an important word there: "systems"—a collection of individual components and devices that act together to perform a specific task-namely, audio reproduction. Each component is dependent on the others to be able to perform its task properly. In our case, we are talking about the signal processing, the amplification, the transducers and the complete loudspeaker configuration all working together.

FIR Filtering

In signal processing, filters play a critical component in what we do. Everything from our crossovers to our EQ is ruled by filters, and in the digital audio world, there are two ways to implement a "filter": IIR and FIR. FIR stands for Finite Impulse Response; IIR stands for Infinite Impulse response. All that we are talking about here is math and a method of changing the 1s and 0s that make up our digital audio signal in a discrete way. Both FIR and IIR filters can be described in mathematical terms using formulas that are too complex to delve into for this article; however, it is fairly easy to characterize the differences and advantages of one over the other.

IIR filters are DSP filters that simulate analog circuits. When we adjust parametric EQs, Linkwitz-Riley filters, etc. inside our DSP, we are working with IIR filters that behave the same way as their analog brethren. IIR filters consume relatively little processing power, and are familiar to work with for most engineers. However, they have the same limitations as analog circuits in that there are restrictions in filter shapes, slopes and phase responses. A target response curve using IIR filters requires a combination of

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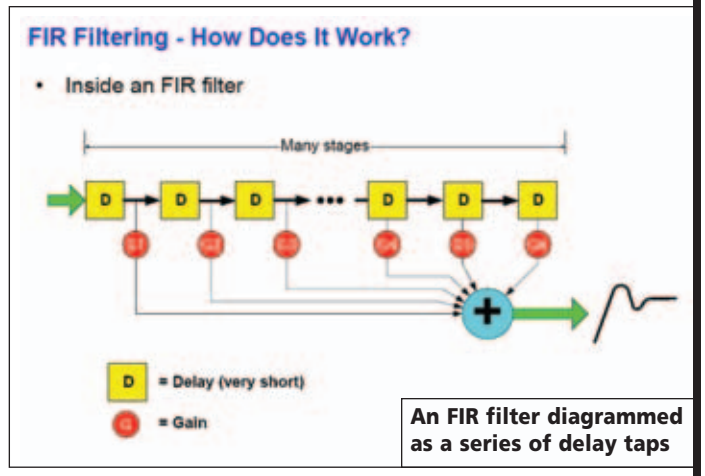

An FIR filter diagrammed as a series of delay taps

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several stages, often requiring compromises in filter slopes, bandpass overlap and overall phase response.

An FIR filter is a whole different animal. Using discrete mathematics, an FIR filter allows a programmer to create virtually any desired frequency and phase response. A single filter can provide extremely detailed and intricate frequency and phase adjustment. Such a filter may be thought of as a series of weighted delay taps.

FIR Products

When comparing FIR filter products offered by a number of manufacturers, it is important to understand exactly how the FIR coefficients are created and just what is done with the filter itself. A vast majority of FIR-based processors are simply using FIR filters to provide brick-wall filters for crossover applications, while still using IIR filters for in-band processing and correction.

EV takes things substantially further by utilizing FIR filters for both crossover and EQ correction—within a single filter-to achieve a linear phase, highly optimized response for an EV loudspeaker system across its entire bandwidth. We start with anechoic measurements of the loudspeakers, then put the measured data through a series of patent-pending engineering tools that calculate the FIR coefficients. These coefficients are exported into a custom "speaker setting" file that is specific to the particular loudspeaker being used. Today, EV offers custom FIR preset files for all of its concert-grade loudspeaker systems and for various other EV models.

What Is FIR-Drive?

We can now answer the question posed at the beginning:

FIR-Drive is the name that EV gives to its entire range of FIR offerings, including FIR-capable processing hardware, custom FIR speaker setting files and related software.

FIR-Drive systems provide a flat, smooth frequency and phase response, uniform directivity at crossover frequencies, smoother total output power, better overall sound quality and require less equalization and tweaking during set up and tuning.

FIR filters are not new in and of themselves; new are the methods for their development and implementation. Modern hardware is finally able to deliver the computing power and performance required to perform FIR processing, a significantly higher order of computing power than IIR processing. EV's new generation of FIR-Drive hardware is up to the task, including the RCM-26 Remote Control Module for the Tour Grade Series of amplifiers, and the new NetMax N8000-1500 Digital Matrix Processor.

The N8000-1500 has at its core two single-core and three dual-core processors to deliver a total of 1500 MIPS of processing power. Additionally, each added I/O card brings an additional 100 MIPS to the pool. Fully loaded, that's up to 32 channels of FIR-based processing, including delays, gain stages, supplemental IIR filters, and EV's advanced Peak Anticipation limiters.

FIR-Drive Array Controller

EV has recently released the FIR-Drive Array Controller for IRIS-Net and the N8000-1500, which takes the approach of creating a ready-made IRIS-Net project file with the complete DSP path and configuration already set up. The Array Controller provides a detailed, optimized and preconfigured DSP structure for operation of sound systems based around EV line array loudspeakers. A single-layer, high density GUI is provided for full access to all needed tuning and control parameters, and provides a ready-to-go, tablet-friendly interface.

The current version of the Array Controller, FIR.1, running on a fully loaded N8000-1500, provides eight analog inputs and 24 analog outputs, 50 3-, 6- and 10-band equalizers (260 bands total), 18 channels of conventional crossover filterss (21 bands total), 12 512-sample FIR crossover filters, 24 peak anticipation limiters, 28 100 mSec delays and 16 10 mSec delays, 80 mixing matrix crosspoints, 576 switching matrix crosspoints and two channels of signal generation—a complete "drive subsystem in a box" for small to medium-sized sound systems.

The Secret Is the System

The system concept is critical in creating a superior audio solution. The way a component interacts with the system as a whole is critical for achieving the best performance possible, and with FIR-Drive hardware, software and development tools, EV is aiming to move sound reinforcement to the next level.

Electro-Voice
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