Resolution Pro™ FIR filter technology for the Versarray Pro 112

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Introduction

A high performance FIR filter has been engineered for the Versarray™ Pro 112 powered line array speaker system. Introducing *Resolution Pro*™ FIR filter technology from Crest Audio®.

Using sophisticated measurement and processing techniques, along with the latest filter software technology, an FIR filter has been designed that does not cause off-axis response problems or add excessive latency to the system.

This filter has been incorporated into the Presets available for the Versarray™ Pro 112 sound reinforcement loudspeaker system. While adding this filter will improve the sound of the speaker system, it does come with a price. The additional precision processing does add a small amount of latency to the system. Use of the filter is recommended when the extra 3.1 milliseconds of latency will not be an issue for the intended use. Some live sound applications may dictate no further added latency on top of the regular system processing latency of 3.6 milliseconds.

Resulting improvements in the sound are related to increased clarity, with a smoother, more precise presentation of complex music material.
Improving the Versarray Pro 112 is a difficult task, as it is a speaker system with the highest caliber of clarity, resolution and smoothness. When the music gets really busy, and the inner detail can become a little bit unfocussed, the new filter can refine the focus, and let the source material shine through more precisely.

How is this performance achieved?

Rather than to trying to correct every little deviation from flat frequency response, like many FIR filter technologies are focused on, or to create a super steep crossover slope using the FIR phase manipulation capabilities, the *Resolution Pro*™ technology aims instead to allow the naturally superior performance of the ribbon tweeters and the 12" Neodymium based Black Widow® woofer to shine through.
Avoiding the textbook methods and flawed FIR inversion techniques, the *Resolution Pro*™ technology focuses on refining the time domain behavior of the Versarray Pro 112, which does not alter the polar coverage pattern, or create inverse FIR comb filtering with every small change in the listening position.
The end result is that the improvements are present and audible all across the normal range of the speaker systems coverage, without any significant degradation of the inherent performance of the truly superb ribbon tweeters or the Neo BW woofer.

Some of the finest equipment and techniques were used to generate the FIR filter coefficients. Studio grade equipment with roots in the Laboratory, such as

precision microphones, ultra low-noise studio caliber mic preamps, using a controlled and scientifically set-up measurement environment to assure only the finest results. A representative sample of the speaker system was selected, and then measured at the best location for the FIR adjustments, based on decades of extensive experience with the ins and outs of loudspeaker acoustics.

What is Music?

Music is a series of transients, as we seldom listen to nothing but organ notes. String together an entire series of different instrument notes all at once, and the transient environment becomes extremely complex and demanding of the playback system. It is then important to have a high resolution capability in the speaker system to provide a means to differentiate those complex transient events. We can examine the resolving performance of a playback system by looking at the time domain, where the sequential and superimposed musical notes can be detected and analyzed more readily than with the frequency domain.

The Time Domain

The time domain can be explored using a type of test signal that starts and stops very quickly for a very short duration. To look at such a test signal, we would use a device or instrument similar to an old fashioned oscilloscope, where the signal is depicted with the horizontal axis the passage of time, and the vertical axis displaying the amplitude.

It so happens that a signal called a Dirac Delta function or Dirac Impulse has these properties. Shown below in Fig.1, is a representation of such a Dirac Impulse.

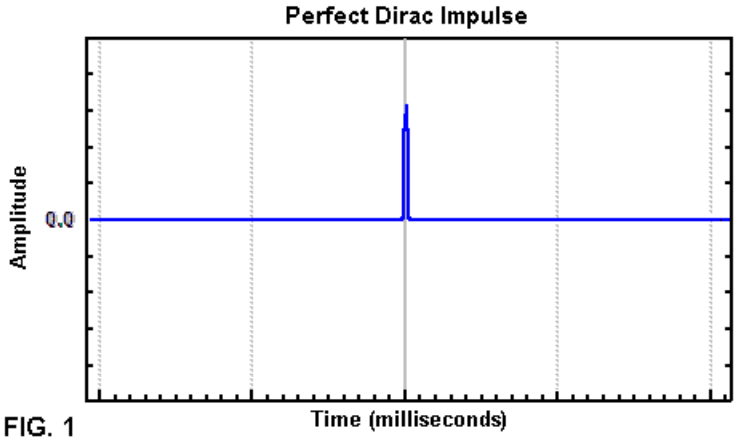

FIG. 1

In a digital audio system, generating such a signal would be a single data point at full amplitude, preceded and followed by all zero amplitude data points.

However, due to the typical reconstruction filters and digital filters used for most digital audio systems, such a simple impulse would then have signal data occur both before and after the main impulse. See Fig. 2.

Note that this is just a simple example representation, and is not completely scaled to match any particular digital system, the ringing seen is due to the specifics of a given system's bandwidth (sample rate) and filter parameters, etc. This output appearance would correspond to most CD players with a digital output filter in use.

Less than infinite bandwidth or less than gentle response roll-offs will cause the Dirac Impulse to broaden in time (bandwidth) and/or to evoke ringing (roll-offs) in the time domain.

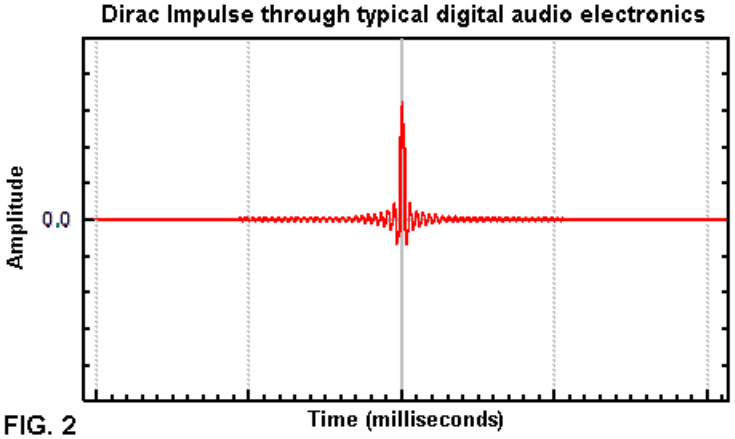

FIG. 2

If that same Dirac Impulse is sent into an entirely analog signal path, there wouldn't be any pre-impulse signal as such, but there would be post impulse ringing of some sort, due to the high frequency roll-off and it's characteristics. This diagram would correlate closely to the output from a CD player with an analog output filter stage for it's reconstruction filter. See Fig.3.

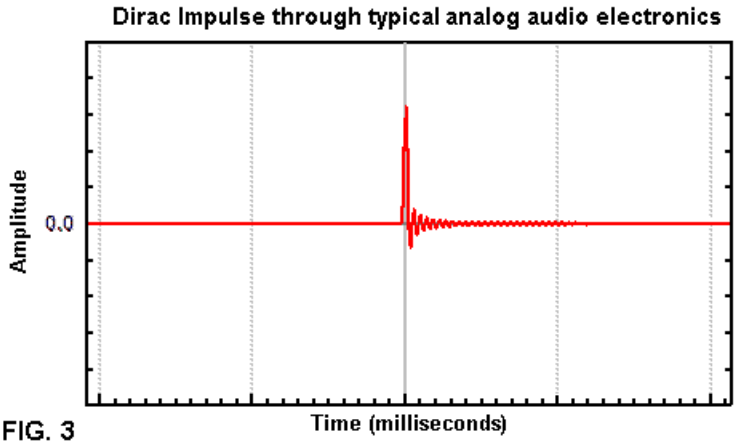

FIG. 3

If we then feed that signal into a Sound Reinforcement powered loudspeaker, and measure it's output, we can see how the loudspeaker system may alter the Dirac Impulse. See Fig. 4

The grey vertical lines spaced horizontally represent 1 milliseconds of time.

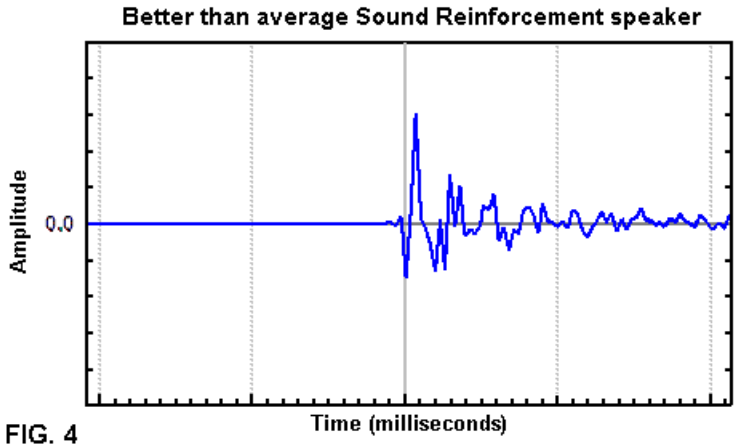

FIG. 4

We can see that what is a well regarded Sound Reinforcement loudspeaker system, can show some hint of what the original Dirac Impulse started with. There is a sharp spike of energy, then a series of deviations from nominal, tied to various imperfections of the speakers used, as well as the steep slope crossover employed to protect the drivers at high power levels.

Most loudspeakers don't do this well, with less capable loudspeaker systems, there is just a series of peaks and dips with deviations from nominal that hang on in time even longer and with higher amplitude, looking even more chaotic. Note that none of what is seen are room reflections or the result of external influences, the time domain record of Fig. 4 is all due to the loudspeaker itself.

All of this leads us to the time domain response of the Versarray Pro 112 system.

Shown in Fig. 5 is the Dirac Impulse response for the default "stock" system, and then the response for the unit with the *Resolution Pro*™ FIR filter engaged.

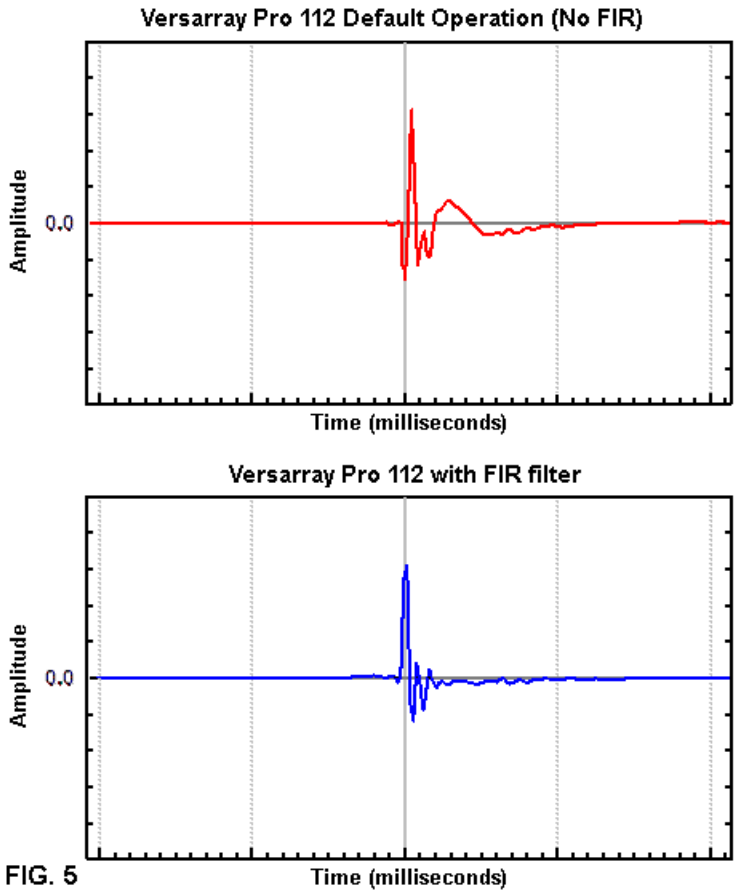

FIG. 5

Note the superior performance and behavior of the ribbon tweeter and Neo BW woofer, without any extra help. The sharp spike of the Dirac Impulse is clearly visible, and the deviations that follow are greatly reduced in amplitude and in their duration in time compared to the Sound Reinforcement speaker system shown before. The excellent inherent response of the drivers of the VR Pro 112, and near perfect mesh of the crossover allow the very high level of performance achieved here in the time domain. However, the phase roll of the high order crossover remains, and this is what is responsible for the small amount of deviations that remain.

Engaging the *Resolution Pro*™ FIR filter then reduces the remaining effects of the crossover phase roll, allowing the full and true performance of the drivers to shine through.

The resulting loudspeaker response is more akin to that of a strictly electrical signal path, with the acoustic Dirac Impulse response that is visible, displaying a close approximation to the input.

This kind of performance is quite simply outstanding, and reveals subtle nuances in the program material, while at the same time, minimizing the irritating effects of less than perfect source material, such as MP3's.

It may seem counterintuitive that a compromised signal source such as an MP3 would listen better with a very high resolution playback system. By removing many of the minor deviations from accurate reproduction, the flaws and lack of full musical signal content are not emphasized as much as they might be, due to the smoother, more accurate signal portrayal. Any grunge of fuzziness already present doesn't get added to or emphasized.
Of course, if a signal is truly awful, then it is still going to sound bad; there is no magic occurring here, just a cleaner presentation of what is actually there.

Conclusion

Where the sound reinforcement application allows, use of the *Resolution Pro*™ FIR filter for the Versarray™ Pro 112 is recommended. The refined performance comes with only the penalty of a slightly higher latency, with no changes to the polar behavior or amplitude response.

NOTES:
All of the depictions of the Impulses have been normalized to a centered time increment, to allow better visual comparison.

Engaging the *Resolution Pro*™ FIR filter on the VR Pro 112 adds an additional latency of about 3.1 milliseconds on top of the default value of 3.6 milliseconds latency for the VR Pro 112 speaker system.