

# SIA Software Company, Inc.

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## SIA-Smart® Pro Case Study #6: Time Correction in a Concert System

*By Ted Leamy, Electrotec Productions*

I recently found myself in New York City, getting the Lenny Kravitz tour set up for an extended run on the road. This year's tour will consist of theaters ranging from 1000 to 5000 seats. A 2000-seat hall had been rented for production rehearsals. Electrotec is providing sound services for this tour using a popular line array system and proprietary Electrotec subwoofers. Smart Pro plays a large role in optimizing Electrotec systems on tour in 1998.

There are a number of parameters that can be changed to optimize the sound system's frequency response in a concert setting. Physical placement of arrays, choice of processing equipment, equalization and time correction of components are all means to this end.

Time correction (alignment) of any sound system is an important part of optimizing the system's frequency response but it plays some other important roles as well. For any large sound system, the issue of time correction can be broken down into three major areas for consideration:

- Alignment of different families of drivers to one another within an enclosure.
- Alignment of various enclosures within in an array.
- Alignment of various arrays and subsystems covering distinct zones of a venue.

In a live concert sound reinforcement system there is one additional, very important role for time correction and that is *alignment of the sound reinforcement system, as a whole, to the actual source (in this case sound on stage)*. This is the topic I would like to focus on here.

In the concert environment, sound systems are meant to be an extension of what the performers are doing onstage. The best sound systems are transparent to the audience, allowing them to focus their attention on the artist on stage without being distracted by the perception of sound coming from some other source. Accurate time alignment of a sound system to the source (the band) can add greatly to the overall concert experience.

The object of this exercise is to "push" the main sound system back in time, aligning it with the source of the music (the band's original stage sound). When this is done accurately, a listener's attention is no longer drawn to the large speaker array. Instead the sound system appears to become a seamless continuation of the artist's stage sound.

This is especially important in smaller venues and in the first one hundred feet of the audience area in large venues. With a few delay lines, Smart Pro, and a small measurement setup this time correction can be made quickly in almost any touring system on a daily basis.

### The Measurement Setup

The measurement setup I used was composed of a laptop running Smart Pro, a small mixer, test microphone, pink noise generator and the connecting microphone cables. The microphone and pink noise generator were connected to the first two inputs of my measurement system mixer. The Aux 1 output was then used to send pink noise to both the FOH console and the monitor console. EQ and inserts for the input channels used on both tour consoles were defeated. The measurement system mixer's main left and right outputs were used to drive the Smart Pro computer sound card inputs.

The Lenny Kravitz band can be a loud stage, and since the drum monitor system can be one of the loudest sources onstage, I chose this as the band's "zero line." My goal is to align the main arrays so they are aligned with the sound from the drums and drum monitors. I began the alignment process by turning on my pink noise generator and unmuting the channel for the drum monitor system on the monitor console only.

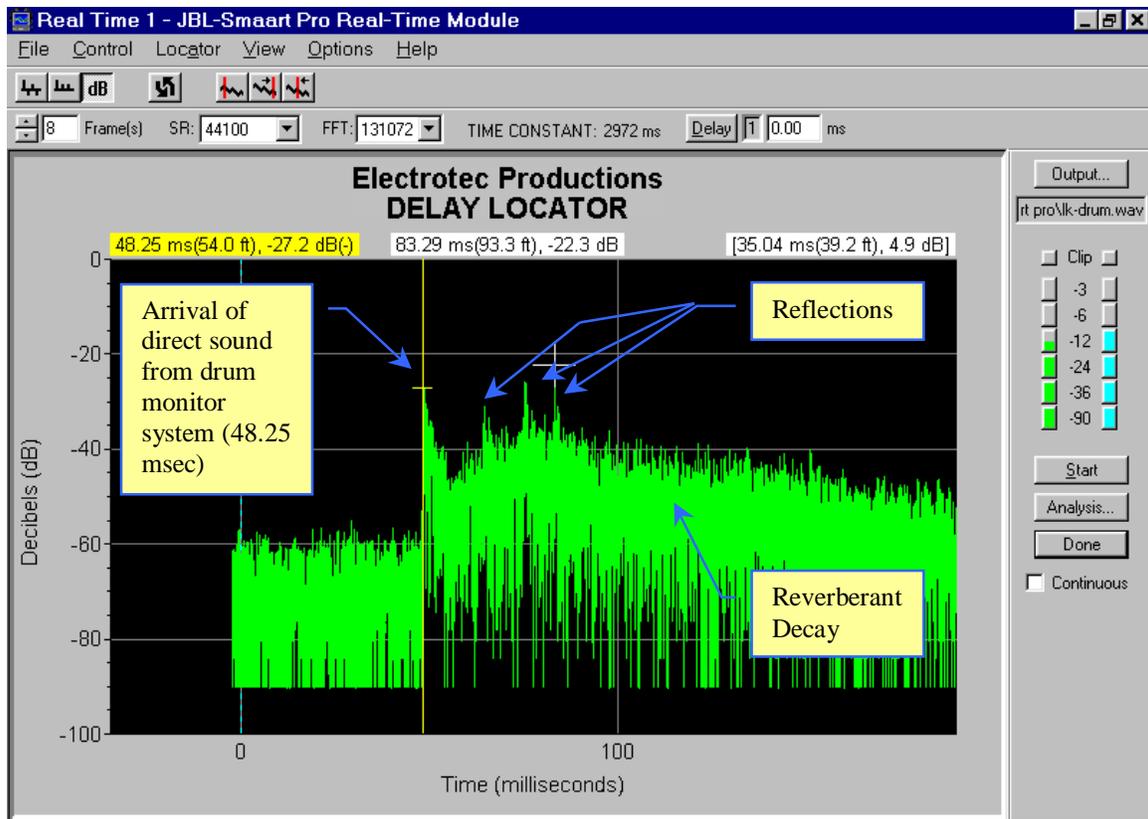


Figure 1: Delay locator plot showing arrival time of drum monitor system only (PA muted). The direct sound from the drum monitors arrives in 48.25msec. Note that there are several reflections of sound after the direct sound from the drum monitor. The drum monitors are pointed upward so these reflections are probably from the ceiling.

With the test microphone placed in a location suitable for a near field measurement of one side of the main PA speaker system, I ran Smaart Pro's delay locator to determine the distance from the drum monitor to the microphone. The results in Figure 1 on the previous page show that the first arrival from the drum monitor system at the microphone position is at 48.25 milliseconds.

It is also interesting to note that in this case, the reflected sound that arrived after the direct sound is actually *louder* than the first arrival. This is most likely due to the fact that the drum monitor system consisted of two wedges and a sub bass cabinet in between, sending much of the energy into the ceiling of the room (and subsequently reflecting a lot of it back).

After noting the arrival time of the drum monitor, the next step was to mute the drum monitor system, un-mute the front of house (FOH) system, and run the delay locator again. The results of this second measurement, shown in Figure. 2 below, indicate that the first arrival at the same microphone location from the house left array of the main PA system was at 28.75 ms.

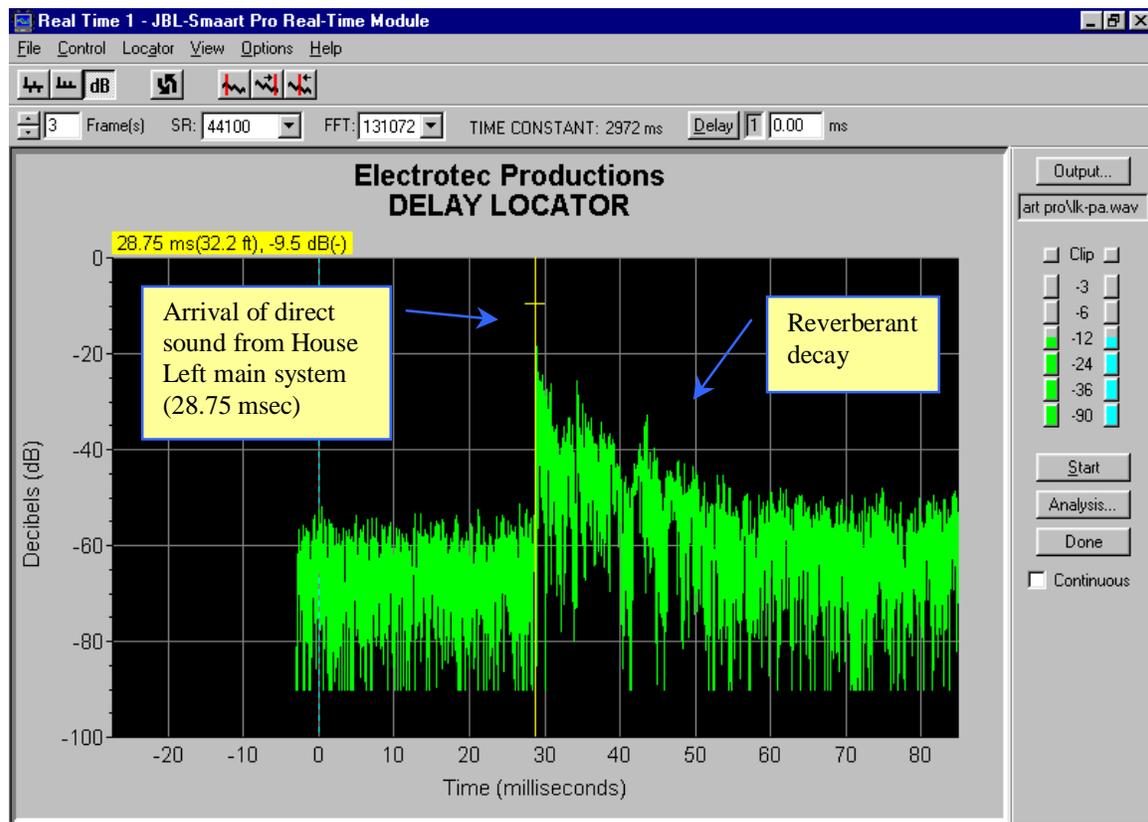


Figure 2: Delay locator plot showing arrival time of the House Left main system only.

Step 3 was to simply turn on both systems (house left main PA and the drum monitor system), and run the delay locator function again. This time, roughly matching the levels of the two systems from the tour console. The results of this measurement are shown in Figure. 3 on the next page.

In Figure 3, you can see the initial arrival times of both the main PA speaker array (28.78ms) and the drum monitor system (48.25ms). The relative cursor readout in Smart Pro (above the plot on the left) indicates that the difference between the two arrival times is 19.47 milliseconds.

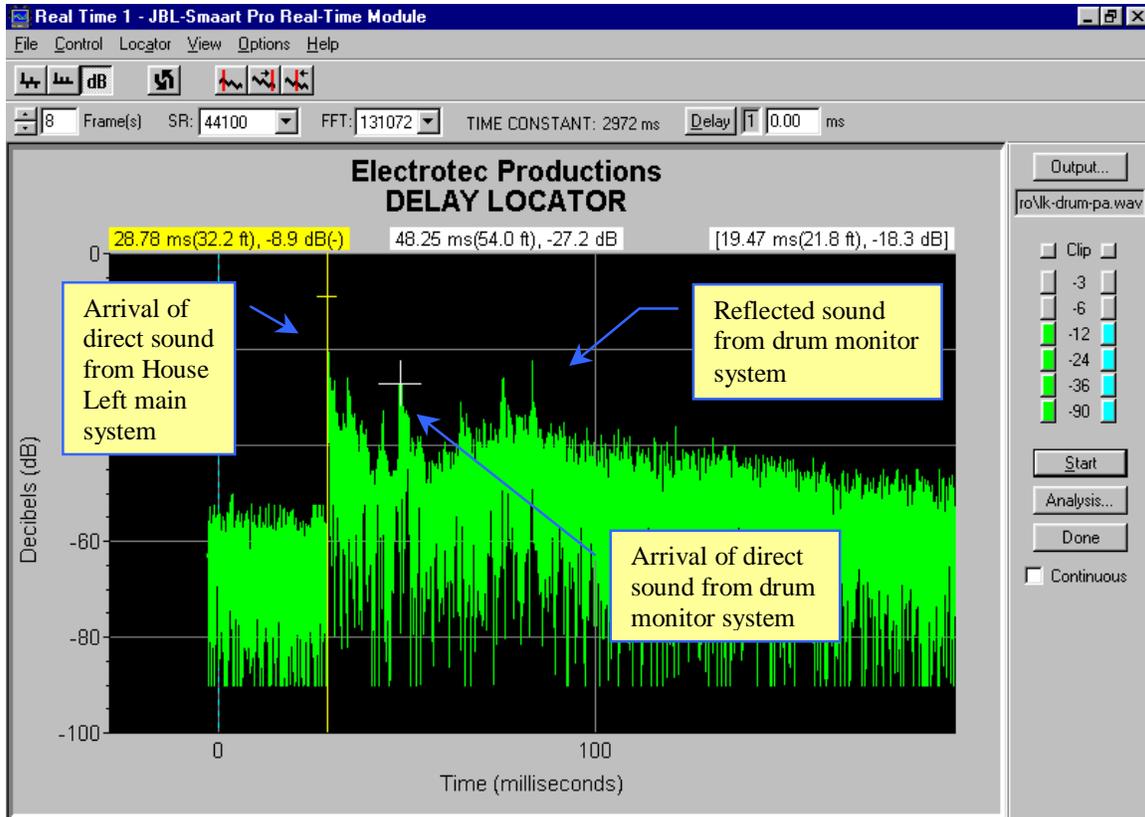


Figure 3: Delay locator plot showing the House left main system and drum monitor system measured simultaneously, before time correction (note the two separate arrival times)

The next step was to set the main delay setting in the BSS Omnidrive system controller used to drive the main speaker system to 19.47 ms., thus “pushing” the main sound system back in time to align with the drum monitor system. The concert audience is now able to listen to a more coherent wavefront, due to the “combining” of the onstage sound with the main PA sound — which would otherwise have arrived earlier.

The final step is to re-run the last test (with both systems activated) to double-check the data after setting the delay time on the main system. Figure 4 shows the alignment of the two systems. Compare this to the results shown in Figure 3, before any time correction was done. You can see that the loud stage sound is now aligned with the main PA sound system and that in addition to the perceptual benefits, aligning these two systems has also helped to clean up the reverberant decay slope for the room/system as a whole.

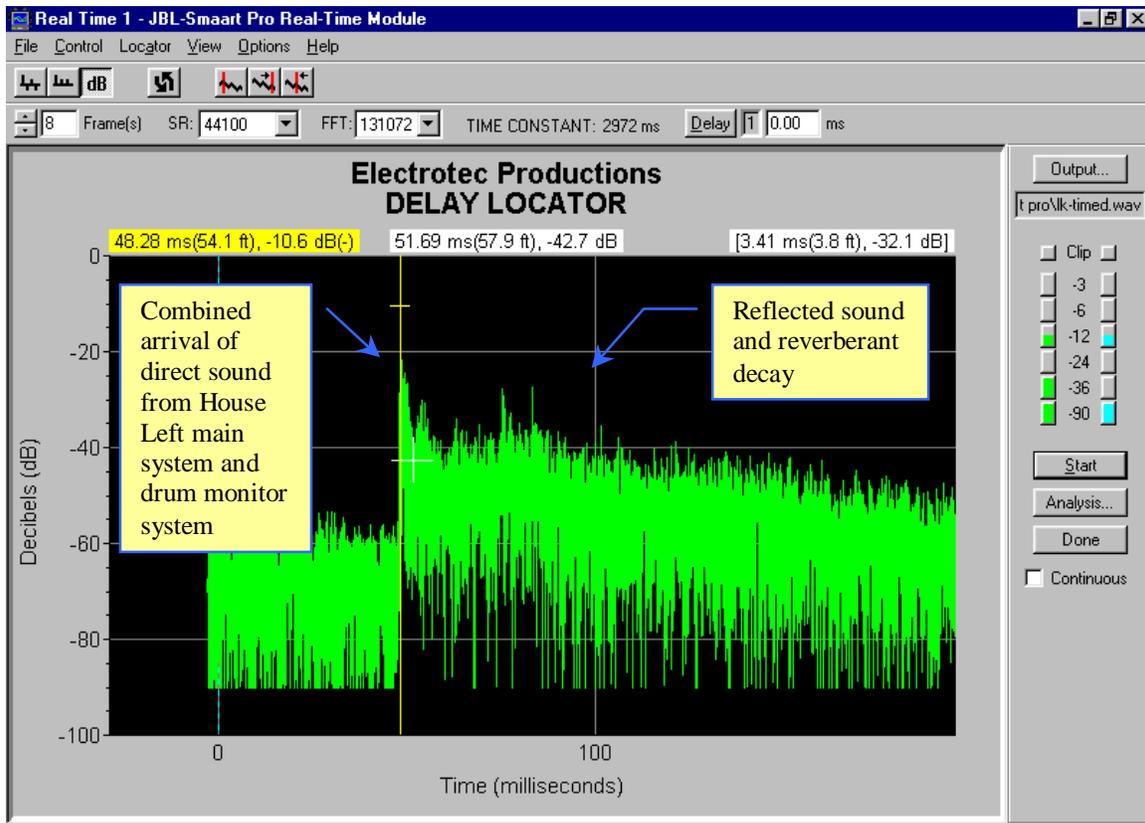


Figure 4: Delay locator plot showing House left main system and drum monitor system after time correction. Note the improvement in the overall decay slope.

## Results

The purpose of any testing and optimization procedure should be to make real-world improvements in a system. If you are willing to spend the few minutes these four measurements require before EQ'ing a sound system, you will be pleasantly surprised when the band hits the stage.

As I mentioned at the beginning, production rehearsals for the tour took place in a 2000-seat venue in Manhattan. This venue, like many others, is not known for its great acoustics. Optimizing the system in this manner made a *huge* improvement in the overall sound of the band. Listening from anywhere in the room, it was difficult to tell what was stage sound and what was coming from the PA.

When the artist came to listen to the PA at the FOH position, he actually thought the system was not turned on and all the sound was coming from the stage. Only after muting the FOH console, and demonstrating an enormous drop in SPL, was everyone convinced that the sound system was indeed running.

It was also noticeable that after aligning the main and onstage systems, the sound cleaned up in the upper bass to lower midrange area of the main system. I was actually able to go back and set some EQ filters flat. This was probably due to the overall improvement of

in the behavior of reverberant sound in the room after the alignment procedure — as is apparent when you compare the two impulse response readings in Figures 3 and 4.

Delaying the main speaker stacks to a performer's location on stage is not exactly a new idea. This has been a common practice in legitimate theater for years. What *is* new is that the speed and accuracy with which it can now be done, using a minimum amount of test gear, makes it practical for live sound system engineers to use this invaluable little trick on a daily basis!

That about wraps it up. If you have questions or comments on this case study or the test setup and procedure, please feel free to post them on the SIA Software Company, Inc. web support forum at [www.siasoft.com](http://www.siasoft.com).

But wait. We're not quite done yet. If you're interested, we also have some pictures from the gig.

*Ted Leamy is the a longtime system engineer specializing in live sound for rock'n roll! His credits include: Rod Stewart, Tom Petty, Rush, and many more. You can reach Ted at either the SIA support forum ([www.siasoft.com](http://www.siasoft.com)) or at [Tleamy@aol.com](mailto:Tleamy@aol.com)*



*Electrotec Smaart setup at FOH on Lenny Kravitz tour*



*Electrotec drum monitor system used on Lenny Kravitz tour.*



*Sam and Ted take a break!*