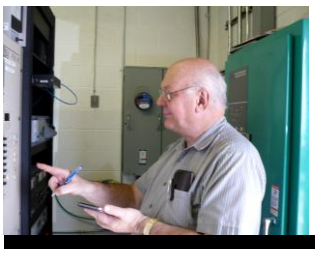


The
Broadcasters' Desktop Resource
www.theBDR.net ... edited by Barry Mishkind – the Eclectic Engineer

SOUND PROCESSING

A History of Audio Processing

Part 4 – Digital Processing Goes into High Gear

by Jim Somich
with Barry Mishkind

[July 2010] In Part 4 of the series, we continue with our look at the people and the products that took audio processing from its analog mode and brought it fully into the "Digital Age."

As in our previous installments, Jim Somich took the lead on this guided tour. I get to help finish it off as a tribute to a great radio engineer. In Part 3, we spoke with Frank Foti. This time, we begin with Bob Orban.

The bridge between analog and digital signal processing was a mixture of new technology and people with vision to apply not only what was on hand, but see where things were going. Bob Orban is perhaps one of the best known of these bridges.

ANALOG MEETS DIGITAL

Jim Somich: Let us take a look back at the dawn of DSP audio processing – and Bob Orban. Bob, I always thought of you as an "analog guru." How did you make the transition into the digital age? It seems like you got real good, real fast!

Bob Orban: I don't write DSP code, but I create the algorithmic architecture and do most of the coefficient computations. In other words, I create "schematic diagrams with parts values" that other engineers at Orban turn into actual code.

I credit my ability to learn DSP in mid-career to an excellent engineering education at Princeton and Stanford that emphasized timeless engineering fundamentals, particularly math. I learned DSP myself by studying textbooks and journal articles, but I couldn't have done it without the university education that I got.

Jim Somich: The Orban 8200 Optimod was the first DSP broadcast processor in the world to achieve commercial success – and that was quite an accomplishment. Bob, what were the influences that moved Orban from being an analog company into the digital era?

Bob Orban: The 8200 project originally started as a DSP model of the Orban 424 compressor using the then-new Motorola 56001 24-bit DSP chips.

The Orban 8200 FM Digital Processor

It was the Motorola 24-bit architecture that finally allowed high-quality DSP filters suitable for pro audio applications. We got far enough along with that to realize that we could build a complete DSP broadcast audio processor that modeled our analog processors and had a few "DSP-only" innovations besides.

At that time, Greg Ogonowski, a long-time friend and "friendly competitor" in the Gregg Labs days, was formally hired as a consultant on the 8200 project.

We decided to make the 8200's multi-band algorithm five-band, as it was in the Gregg Labs processors, instead of six-band as it has been in the XT2. Overall, though, most of the influences for the 8200 came from earlier processing I had developed, including the 8100 and the XT2.

We learned a lot doing the 8200, and I combined this with new ideas that could finally be realized because we now had enough DSP power to pull them off. The 8400 was the end result. I should add that the 8400 project was the first Orban DSP-based processor that really exploited the things that one could do in DSP that were impossible in analog.

The full DSP Orban 8400 introduced several new features

OPENING UP NEW POSSIBILITIES

Jim Somich: That certainly sounds like a major jump forward. What sorts of things were now possible using DSP?

Bob Orban: In my opinion, the big advantage of DSP compared to analog processing is that one can implement "look-ahead processing" economically because making delay lines is just a matter of writing data to memory and reading it out later. By being able to "look into the future," the DSP-based processing can make intelligent decisions that are impossible in analog designs.

Look-ahead limiting is just one example of look-ahead processing. The 8400 and 8500 also use look-ahead processing for clipping distortion control and for our "half-cosine interpolation" composite limiting, among other functions.

Another important thing we did in the 8400 was to add a speech/music detector, which allowed the processsing to be optimized separately for speech and music. Some of the most sophisticated of the old-school, major-market processing chains actually had separate speech and music processing because these really require separate adjustments. DSP allowed us to do this automatically within one processor.

COMPLAINTS FROM THE FIELD

Jim Somich: Some surprising feedback came from the field as people dealt with the effects of the look-ahead limiter. What happened?

Bob Orban: The most important decision that we had to make before designing the 8400 was whether it was acceptable to make a processor with a throughput delay so long that it was impractical for talent to monitor its output through headphones when speaking. We assumed that the improvements in processsing would be more important to broadcasters than the inconvenience of arranging a separate monitoring chain for talent headphones.

Unfortunately, we were surprised when the 8400 was released – we got lots of complaints about headphone monitoring. Accordingly, in Version 2.0 of the 8400 software, we cut the delay in half without compromising the look-ahead algorithms by looking at every delay in the chain and getting rid of the ones that were not actually necessary to implement the look-ahead processing. We also allowed users to configure the 8400 to emit a low-delay headphone monitor signal from an unused output.

When we designed the 8500, which maintained a 64 kHz minimum sample rate (as opposed to 32 kHz in the 8400), we further reduced delay by about another 4 ms by eliminating 64/32 and 32/64 kHz sample rate conversions in the signal path.

However, even with all this effort, the best-quality processing available in the 8500, using look-ahead in the most favorable way to reduce distortion, exhibits a 37 ms delay – which is too long for headphone monitoring. Fortunately, most of the advantages of look-ahead processing are available with a 17 ms delay, which is the delay of most of the 8500 factory presets. Additionally, we made available a separate ultra-low-latency processing chain without look-ahead for those applications where the low delay was considered necessary, such as remote off-air cueing.

COMING ATTRACTIONS

Jim Somich: We just have to ask: Would you care to take out your crystal ball and give us a few predictions on what we can expect from Orban in the future?

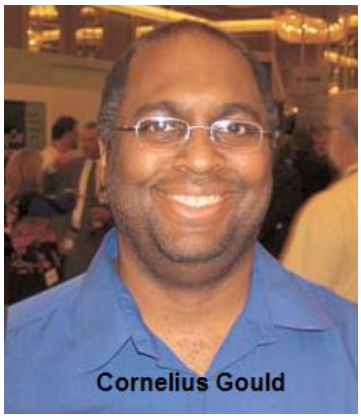
Bob Orban: That would be telling! Seriously, I don't want to say anything that might give away future plans to my competition.

Jim Somich: We are a bit disappointed, of course, but do understand. Thank you for taking the time to share with us as much as you did.

THE NEW GUYS

At this point, having spoken with two of the major established processor designers, it might be a good idea to check in on a couple of the "new guys on the block" as their ideas come to the marketplace.

Jim Somich: Cornelius Gould is one of these guys relatively new to the DSP scene, but I know he has been working in analog for years. Corny, who are your gurus? Who influences your processing ideas?



Cornelius Gould: Several people have influenced me over the years; definitely Steve Church and Frank Foti. Both of them are examples of how ordinary engineers with a dream can take them and grow them into a life-style. They also show the joys of having to continually raise the bar on what they do, aim to top that, and reset the bar again.

Others include Glen Clark and Bob Orban – what current processsing geek has not been influenced by him? The thing I admire about Glen's work is that he showed us another way to look at the audio processing control system design. His work on the Audio Prism showed me to never be afraid to look at audio processing from a different angle. Just because an idea is a radical departure from what was done before does not make it bad.

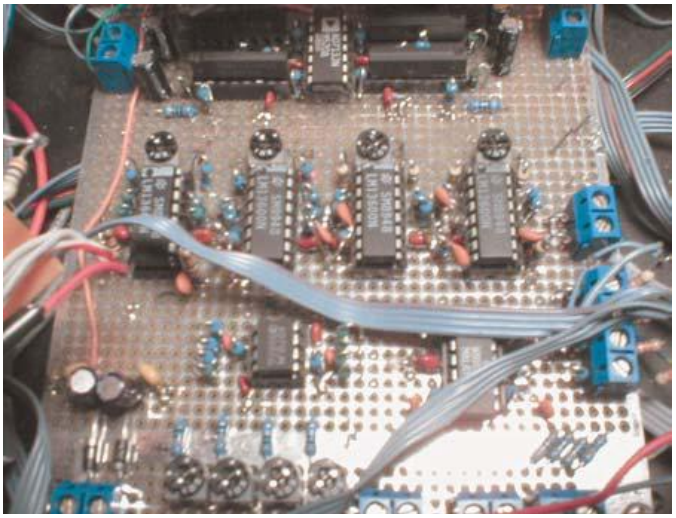
My other influences have come from my contact with various end users over the recent years. As you and others are aware, I've been heavily focused on trying to teach the new generation of end users about how to use audio processors. I've had a few seminars on the topic at a couple of state broadcast conferences. Out of this came some ideas on different approaches to user interaction with an audio processor.

BECOMING A DIGITAL DESIGNER

Jim Somich: What is your DSP experience? How do you operate? What development systems do you use?

Cornelius Gould: I've dabbled off and on for about 10 years with DSP development systems. I've been heavily researching DSP concepts and developing new ideas that can only be done with the power of DSP.

Gould's "Internet Chameleon" was largely based on VCA technology he learned working with Frank Foti



The op-amp base "Audio Chameleon" made its debut on several FM stations in the Cleveland market.

Jim Somich: Do you have a current DSP project? Can you talk about it?

Cornelius Gould: Currently, I'm working on new ideas that I couldn't do in analog. Namely, having the audio processor be smart. Since we are basically dealing with computers, whether a hardware-based DAP box, or PC software. Why not take advantage and really build some "intelligence" into the audio processor?

Since a lot of what I'm working on hasn't been tried in any existing processor yet, I naturally won't elaborate more on this. You never know what I may do with these new techniques!

Jim Somich: What, in your opinion, is the current state of audio processing and what do you see in the future? Are you doing anything with processing for HD Radio?

Cornelius Gould: The bulk of what I'm experimenting with apply *directly* to HD Radio and any other "coded audio" based content delivery system. For almost ten years, I have been running various streaming stations on the internet. In my natural effort to make them sound their best, I have been developing a steady stream of tools to deal with coding artifacts. As luck would have it, the new wave of digital broadcasting could be described simply as "streaming audio over RF." Almost overnight, it seems, there are suddenly lots of outlets I can throw my ideas at.

[One culmination of this design work was in view at the 2010 Spring NAB Show. The Omnia 11 was displayed, the result of merging Gould's work into Foti's, in effect a reworking of many of the assumptions driving processor development in recent years. Delivery of the Omnia 11 was slated to start in summer 2010.]

Foti and Gould at NAB 2010

Jim Somich: Thank you sir.

RADIO AUDIO CAPTURES THE TIMES

Challenges to broadcasting are everywhere, from iPods to satellite radio to Internet Radio – and to that unknown new gadget or gizmo that is just over the horizon. In fact, the way things have been going over the past decade, it even might appear that free-over-the-air terrestrial broadcasting has a target painted on its back. I think the future is brighter, and the audio processing of the future will be a large part of it. That will be our theme next time.

Want to know when the next section is added? Sign up for the BDR Newsletter.

The History of Audio Processing – index of the complete series

Return to The BDR Menu