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Recorded Music Gets Dose of Reality

By JAMES GLANZ

When Thomas Edison first demonstrated his phonograph to packed houses in the 1870's, the feat seemed so remarkable that listeners occasionally fainted. Digital recordings and stereophonic sound have created a much less impressionable listening public, but Dr. William M. Hartmann, a physicist at Michigan State University, recaptured a little of the old magic when he played a radically new type of recording for a jammed conference room during a meeting of the Acoustical Society of America two weeks ago.

The way Dr. Hartmann recorded and played back a Mozart string quartet in B flat seems simple enough that it is hard to believe that the showmanlike Edison did not try it himself. But acousticians who were there said that nothing like the demonstration had been achieved before, and that it provided a glimpse of a spectrum of recording techniques that could eventually turn up in living rooms of the well-to-do and at elaborate social gatherings.

On two channels of an eight-channel digital recording, Dr. Hartmann managed to isolate completely the sounds of the first violin during the original performance. He did the same with the second violin, the viola and the cello. In replaying the quartet, he gave each pair of channels its own speaker, built to have sound radiation patterns broadly similar to those of the stringed instrument, and he arranged the speakers on the floor just as the musicians originally sat.

The result was seven minutes of chamber music in which the audio "image" of the players was all but palpable, an unachievable feat for two-channel stereophonic sound. And, the usually inevitable distortions, created by transmitting more than one instrument through a speaker, were absent. "It was so convincing," said Dr. Leo L. Beranek, the dean of the world's architectural acousticians, who is at Acentech Inc., in Cambridge, Mass. "You moved around and the instruments seemed to be coming from a live group."

The seemingly live musicians also sound as if they are playing in the room where the speakers sit, since no reverberations from the hall are preserved on the recording. Dr. Beranek said he thought the setup could generate its own reverberations and maintain the sense of live presence in surroundings ranging from a large living room to the New England Conservatory's Jordan Hall in Boston.

A sliver of the old sense of excitement is back, too, said Anthony Hoover, an acoustician and principal consultant at Cavanaugh Tocci Associates who led the session in Columbus, Ohio, where Dr. Hartmann gave his demonstration. "Not only were people thrilled, but there was standing room only," Mr. Hoover said.

Although the demonstration dealt only with a specific way of recording a string quartet, Mr. Hoover said the effort should be seen as an exploration of the possibilities that would be opened up as DVD technology allowed for more and more channels and speakers. "It's very clear," Mr. Hoover said, "that the industry is moving in that direction."

There are several good reasons Edison could not have recorded a string quartet in the way that Dr. Hartmann and his students, Zachary Constan and Timothy McCaskey, did. The project required computers with memory capacities of a gigabyte and the ability to handle eight channels of digitized music simultaneously. And while the technology for isolating instruments from one another with "pick-up" or contact microphones has existed for at least several decades, mixing those sorts of recordings to produce the realistic and pleasing sounds of classical instruments is still far from routine.

And when it comes to reproducing the three-dimensional aspects of a string quartet, the complexity of the sound pattern radiated by just a single violin shows what the physicists were up against.

Studies by Dr. Gabriel Weinreich of the University of Michigan, have revealed that at sound frequencies below about 850 hertz, or oscillations per second, roughly a G sharp an octave and a half above middle C, a violin radiates its sound almost uniformly in all directions. But above that point, with higher frequencies and thus higher notes, the violin has what Dr. Weinreich calls directional tonal color, meaning that the instrument emits sound louder in some directions and softer in others, with patterns that are different at nearly every frequency. "All of that is folded into what we call the violin sound," Dr. Weinreich said.

Such complexities in each of the individual instruments meld together in a way that depends on how they are arranged on the floor or stage, creating the dynamic, three-dimensional, acoustic presence of a string quartet.

Realizing that it would be impossible to recreate every detail of that acoustic image (a term used by analogy with visual images of three-dimensional scenes), Dr. Hartmann focused on what he thought were the most crucial brush strokes, like realistic painters who convey a sense of space without reproducing every cornice, leaf and cloud.

He began by recording each instrument with two contact microphones, one affixed to the instrument's body near the squiggly "F hole" and one near the bridge, as four Michigan State music students played the Mozart quartet nicknamed "The Hunt" (K. 458). The acoustic vibrations picked up by the two microphones were quite different; the relatively stiff bridge transmitted a greater range of high frequencies, many of them corresponding to harmonics of the principal note being played.

Dr. Hartmann experimented with different mixes of those pairs of digital recordings that made it sound as if the right tones were coming from the right places. But in order to do that, he had to send the sound through special loudspeakers with two sets of low-frequency woofers and high-frequency tweeters on the front and one set on the back.

On the front, one woofer-tweeter pair transmitted sound collected mostly from an instrument's bridge and the other pair played sound recorded from the F hole. The back pair transmitted the F hole channel with some of higher frequencies filtered out, since more low frequencies tend to be radiated backward in a real instrument.

Then the loudspeakers were arranged like the corresponding players in a string quartet.

"If you want to pick up the cello stand and put it some place, why then the cello will be there," said Dr. Weinreich, who also attended the Columbus meeting. "The different tracks are very clean in recording the individual instruments," he said.

Dr. Weinreich said the arrangement also created at least a rough approximation of directional tonal color for each instrument. Scaling the setup to a larger ensemble would not necessarily involve more channels, Dr. Hartmann said. For example, electronic switching might allot an individual speaker to a soloist and share the remaining speakers among the other instruments. For a symphony orchestra, he said, "obviously we're not going to have 100 channels."

If more string quartets could be recorded and those recordings made available, Dr. Beranek said, there might already be a demand for the system at classy social functions.

"They could just set this up and have it play," he said. "It would be very realistic and do the job just as well as live players."

But Mr. Hoover suggested that the work's significance might lie more in its general approach to using multiple channels rather than in this particular realization of a string quartet. The demonstration could be seen as a first test of ways to use the multiple channels that are becoming available with DVD and related technologies. Six-channel systems are available now, he said, and 10- and 12-channel systems are said to be in the pipeline. With the proper placement of speakers, existing systems are good at conveying, for example, the sound of a helicopter as it passes overhead in an action movie. But the extra channels are often wasted on music, which blares out of all the speakers equally.

No matter how good the new systems improve upon Edison's phonograph and its progeny, musicians warn that there is still no substitute for a live performance.

"I fancy myself, within my budget, a semi-stereophile, and it's fascinating to see how close someone can get to the old absolute sound," said Dr. Robert Greenberg, a pianist and composer, who is chairman of the music history and literature department of the San Francisco Conservatory of Music. Still, Dr. Greenberg said, the best live music involves "the performance feeding off the energy coming up from the audience."

It doesn't matter," he said, "if it's a Bruce Springsteen concert or the Guarneri Quartet. If you want the thrill and discovery of the interactive act, then it has to be live."

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