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Play It Again, Vladimir (via Computer)

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THE house lights dimmed at the BTI Center for the Performing Arts in Raleigh, N.C., one night last month, the stage lights came up on the grand piano, and in front of a rapt audience Alfred Cortot played Chopin's Prelude in G (Op. 28, No. 3), as he had not for nearly 80 years.

Cortot is dead, of course. He was not present in physical form, nor was anyone else sitting at the keyboard of the Yamaha Disklavier Pro as the keys rose and fell. But this was his performance come back to life: his gentle touch, his luminosity, even his mistakes, like the light brush of an extra note at the periphery of the final chord.

So, at least, claimed Dr. John Q. Walker, the president of Zenph Studios in Raleigh, which sponsored the event and created the software that allowed Cortot to return. Dr. Walker is developing technology that enables him to break down the sounds of an old recording, digitize them and reproduce them on a Disklavier, an up-to-the-minute player piano that can record and replay performances by means of a CD in a slot above the keyboard. Sophisticated fiber optics control the instrument's hammers.

Old recordings of great performers are often marred by scratches and surface noise, or by sound badly filtered through primitive microphones. Dr. Walker is offering the same music with the immediacy of live performance and the acoustical advantages of a contemporary piano. To demonstrate the contrast, Dr. Walker also let the audience at the BTI Center hear the original Cortot recording from 1926, which sounds as if sand had been poured on the old disc's shellac.

"The farther you get from the recordings, the worse they sound," Dr. Walker said by phone a few days before the concert. "The fundamental root of the problem is that I don't want to hear a recording. I want to hear the young Horowitz, Schnabel, Fats Waller, Thelonious Monk on an in-tune piano."

If the claims he is making for his new technology are accurate, he will soon be able to. His plan is to approach the major labels with his software and delve into their back catalogs, acting as a record producer to make old recordings new. Josef Hoffman without the scratches, Glenn Gould without the mumbling: brought back to life and performing on modern pianos, recorded with modern technology.

"People say this is like colorizing old photographs, but it's not," Dr. Walker said. "This process is like being able to set up the entire scene of that photograph again and shoot it with a new camera from any angle, forever."

This is the new world of computer music. In its infancy, way back in the 1960's, the goal was to use digital technology to create new sounds and new musical forms. Today scientists around the world are turning computers on human performance, seeking to quantify an element once thought to be intangible: the expressivity of a human artist.

The piano is a good place to start. It offers a relatively limited set of variables. With the violin, every aspect of sound production is subject to human vagaries: bow pressure, bow speed, the placement of the fingers. On the piano, it comes down to hammers hitting strings.

Developed by Wayne Stahnke, the first Disklaviers were made in the 1980's by Bösendorfer, the renowned Viennese piano manufacturer. When that company stopped making them, Yamaha took up the baton, hiring Mr. Stahnke as a consultant. Mr. Stahnke's best-known Disklavier project was a foretaste of Dr. Walker's efforts: translations of piano rolls recorded by Sergei Rachmaninoff. The two resulting CD's of "new" Rachmaninoff performances, both called "A Window in Time" and released in 1998 and 1999, are still available from Telarc. Some listeners find these revelatory. Some find them mechanical, even soulless. The reactions demonstrate a basic difficulty with mechanical reproduction of music: there is a subjective element involved in determining if it works. The final criterion for any such reproduction is the rather imprecise "Turing test" of artificial intelligence: that is, whether it can make the listener think he or she is hearing a person rather than a machine.

At the Austrian Research Institute for Artificial Intelligence, a group of leading researchers known as the Machine Learning, Data Mining and Intelligent Music Processing Group are trying to pinpoint just what it is that fools the ear. Led by Gerhard Widmer, they are looking at everything from improving the way computers "hear" music to isolating the elements of individual performance style, as well as creating graphs and animations to illustrate different pianists' interpretations of the same passage of music.

In a 2003 paper, "In Search of the Horowitz Factor," Dr. Widmer and his team described giving the computer 13 recordings of Mozart piano sonatas, played into a Bösendorfer Disklavier by the pianist Roland Batik, to see if they could use the computer to determine rules that described the pianist's interpretive choices.

They did get some rules, though it turned out that many of them applied equally well to other performances of other music. But the machine generated its own performance of a Mozart sonata movement that it had not heard Mr. Batik play, but based on what it had learned of his style. With this, it took second prize in the International Computer Piano Performance Rendering Contest in Tokyo in 2002. With no stage fright.

"The first question was, can we hear Glenn Gould play again?" Dr. Walker said. "The next question: Cool, can we hear him play other stuff?" To this, Dr. Widmer might answer: We're getting there.

But there's still the thorny matter of how to get data from an audio recording into the computer. It's a question not just of having the computer play back a CD, but of translating the music into a language the computer can understand.

A computer, by itself, can't recognize the difference between a note of music and a cough. It can't pick out a melody from a dense weave of counterpoint. It can't tap its foot to follow a beat - not, at least, in classical music, where the tempos are constantly changing. The first problem Dr. Walker faced was how to get the computer to create a kind of score from the clusters of sounds in a recording.

"A recording is sound waves that were sampled by a microphone," he said. "We feed those into the computer and try to discover what the notes are. The computer model is a three-dimensional thing: middle C struck in a certain way looks like a 3-D mountain range. We have a model that looks like math equations, and we try to fit to it: Yeah, this looks like it's a note."

Dr. Walker - a trained pianist with a degree in software engineering who sold his company a few years ago, creating the time and financial flexibility to work on this project - is coming up with his own answers. But the process is still extremely time-consuming. He is reluctant to say just how slow it is, but he has been working for more than three years, and his demo CD includes only a few tracks: the Cortot, Glenn Gould's performance of the Aria and first variation of Bach's "Goldberg" Variations, and part of a track by Art Tatum.

Even after he gets a model that works, Dr. Walker has to contend with the question of reproduction on a Disklavier: can it mimic human performance down to the last detail? Dr. Werner Goebl, a member of Dr. Widmer's team in Vienna, addressed this as co-author of a paper called "Are Computer-Controlled Pianos a Reliable Tool in Music Performance Research? Recording and Reproduction Precision of a Yamaha Disklavier Grand Piano." Precisely measuring the Disklavier's ability to replicate human touch, Dr. Goebl answered his own question: No.

Less high-tech but just as relevant are the variations from one piano to another. A skilled musician compensates for changes in a room or an instrument. A CD cannot. Dr. Walker encountered one aspect of the problem when he took his technology to the Yamaha studios to play his Cortot performance for Mei-Ting Sun, a young concert pianist and the winner of the first Piano-e-Competition in 2002 (judged, in part, via a Disklavier in Japan, which reproduced performances thousands of miles away for one of the judges).

It had to do with the final chord in the Chopin prelude - or, rather, with the extra, wrong note.

"Their piano wasn't calibrating as ours was," Dr. Walker said, "and the note didn't sound. Mei-Ting said: 'I know this recording. This wasn't accurate, because Cortot misses the last chord.' I played it again, and he watched the keyboard and saw that the key went down but didn't sound. He said, 'O.K., you guys got it.' "

Mr. Sun was so convinced that at the North Carolina concert where Dr. Walker's version of Cortot made his debut, he appeared as the featured live artist: Cortot played a piece, Glenn Gould played a piece, and Mr. Sun played the rest of the evening. He had to; Dr. Walker didn't have enough music to fill a whole recital.

The technology, in short, is still in its infancy. But Dr. Walker is animated by his vision of the future. Like other scientists - including Dr. Goebl in Vienna, another serious classical musician - he envisions a future of interactive recordings. "We've been trained that a recording is a frozen document," he said. "Why can't it be like a video game - every time you hear a recorded performance it's different?" But at the moment, his focus is on making new recordings in a more conventional manner.

Dr. Goebl, in Vienna, supports Dr. Walker's work and is interested in it. But he questions whether it's a "real" performance. (Dr. Walker is well aware of such skepticism; his response is simply that you can't judge until you've heard it.) "The timing you can probably get quite right," Dr. Goebl said. "What is really difficult is to get how long the notes were held and how the pedal was moved and so on. You don't have that information. You can just guess. The result is something that sounds like but never truly will be Gould. It's always an approximation."

So is he saying that Dr. Walker's track isn't authentic?

"There you have to go into the philosophical domain," Dr. Goebl replied. "A recording is just an acoustic document of what took place."

In other words, a recording isn't authentic, either. It is also at a remove, or two or three, from the original performer, and it is also affected by the decisions of the engineers who helped create it.

The Gould recording, after all, wasn't recorded in one take. Many different takes were spliced together to create it. Is it any more real than a computer replica? Only if you say it is.