The Zenph Experience

Extracting Gesture and Sound from Original Recordings

Andrew Quint

Experiencing the phenomenon in person for the first time, it seems almost a supernatural occurrence. As I walk around the nine-foot concert grand and watch the keys move with dizzying speed and subtle refinement, observe the pedals being depressed, and hear the torrents of sound emanating from the MIDI-equipped instrument, I'm gradually aware of another presence, the materialization of an artistic spirit. I was already quite familiar with the three Sony releases for which Zenph Sound Innovations is responsible, "re-performances" of programs by Glenn Gould, Sergei Rachmaninoff, and Art Tatum, but I wasn't prepared for this. Though no musician's in sight, I am indeed witness to a "live" performance, the creative act itself.

I've come to North Carolina to see first-hand what Zenph is about. My host is John Q. Walker, Zenph's founder and chairman. A youthful 55, Walker now oversees a staff of thirty, thanks to an infusion of outside capital. Zenph, it turns out, is an intentional misspelling of *Senf*, the German word for mustard. From the company's Web site: "We liked the business model of the mustard plant, which grows strong from a tiny seed."

The idea of authentically recreating musical performance germinated early. As a high school senior, Walker took piano lessons with one of Rachmaninoff's two students, Ruth Slenczynska. "Not, by the way, because I'm a good pianist," he allows, "but because she and my folks were about the same age and were good friends, and lived on the same street. She'd say: 'John, here's how Mr. Rachmaninoff would have played that.' And she'd show me. And I'd think: 'I'd like to hear *him* play it!' That was the moment."

The implementation of this ambitious goal would have to wait several decades. Walker studied piano and mathematics as an undergraduate before earning his doctorate in computer science at the University of North Carolina. He remained in the Raleigh-Durham Research Triangle, the East Coast equivalent of California's Silicon Valley, first at IBM where he directed teams of engineers developing high-speed networking. Though on track for a high-level management position at Big Blue, Walker departed after 18 years to co-found Ganymede, a company specializing in network performance software. After five productive years, he sold his interest to start Zenph.

Walker meets me at the Raleigh-Durham airport and we drive to his home in a quiet, wooded area of Raleigh. Zenph will be moving into a permanent space in downtown Durham shortly and a few dozen employees can already be found in temporary quarters nearby. But the nexus of Zenph's activity for now is Walker's large, modern house, situated at the end of an impressive, curving driveway. ("The last business did OK.") Most of Zenph's engineers, researchers, programmers, and musical analysts are in North Carolina now, but some are still based at a distance. Walker houses them for their periodic visits, and local Zenph employees filter in and out. In the kitchen, in the dining room, in the den, intense younger men in groups of two or three type away at laptops. Built onto the house is a substantial recital hall, its design based on a room at Richard Wagner's Wahnfried in Bayreuth. The dimensions of the space are 37' by 21' with a 23' ceiling. I'm wondering how Walker managed to get this constructed in a residential neighborhood, and he shows me the architect's plans. The room, which should easily hold an audience of 80, is modestly labeled "Home Theater."

On the stage of the recital hall are two nine-foot grand pianos, both equipped with computer-driven playback mechanisms, a Yamaha Disklavier Pro, and a 1909 New York Steinway, its mechanism built for Walker by the British engineer Richard Shepherd. (In the back of the room is Walker's "reference instrument," a gorgeous 1886 Steinway D.) Walker touches a computer and the Yamaha launches into Sergei Rachmaninoff playing "The Star-Spangled Banner," the piece with which he opened hundreds of concerts as he toured the United States. Any conception of Rachmaninoff as a histrionic Late Romantic banger is instantly banished. The performance of this throwaway material is majestic, deliberate, dignified, and weighty—the mass of the pianist's famously large hands is palpable. I also hear George Gershwin playing sections of his F major Piano Concerto and *Rhapsody in Blue*. The fluent urbanity of Gershwin's keyboard style comes through

as lucidly as if one were actually hearing the composer extemporize at a penthouse soirée in the 1920s.

Next up, on the 1909 Steinway, is Oscar Peterson, a selection from what will be Sony's next Zenph release—re-performances of nine tracks played on a Bösendorfer and recorded at Abbey Road in London last May. The sense of a powerful imagination in complete control of the instrument is tangible, as one follows the profoundly logical yet unpredictable fantasies that constitute Peterson's improvisations. His effortless technique never comes across as mechanical or sterile, even with the piano bench conspicuously unoccupied. "We worked with Oscar in 2007 when he was still alive," Walker tells me. "He was, like, 'I want to hear this!' He was always a technophile. Always had the latest camera, the latest…whatever. He literally had us shipped up to his home in Toronto. Yamaha set up one of its pianos in his living room and we spent a whole afternoon playing Oscar Peterson for Oscar Peterson, Art Tatum for Oscar Peterson. There was a file of "Tenderly," which he used to play quite often. That was the only Peterson file I had given Yamaha and the engineers played it as a test. Peterson's manager Ron was in the basement, and comes running upstairs: 'Oscar! Oscar! There's someone playing *just like you*!' And Oscar turns to him and says 'That *is* me!'"

Zenph's methodology is to analyze the audio waveform coming off a given medium—LP, CD, videotape, wax cylinder—in a highly advanced fashion, parsing a number of relevant variables, perhaps a dozen in the case of a piano recording. These include such musical factors as pitch, start time, duration, attack, release, loudness, and timbre; a number of these metrics will correlate with a physical aspect of piano performance, such as the velocity of the hammer as it strikes the string, or the exact way the pedals are utilized. The data are then used to create a re-performance on a suitably equipped playback instrument. Walker emphasizes that with a complex musical composition, Zenph's analysis is not a "program" but "a *process* with many steps, many pieces of software, and many checks and balances." There are aspects that are automated, but human judgment remains a critical component. Walker has six performance analysts on his staff, and their input is essential to achieving an artistically valid final product.

Zenph's Gould re-performances signal that Walker knows the difference between what he *should* do, as opposed to what his process *can* do. In the recital hall, back on the Yamaha, Walker plays Variation 27 from Gould's celebrated 1955 *Goldberg* Variations and points out a mistake, a slip of the finger that was left in by the notoriously fastidious performer. It's not easy to hear, even if you're listening for it, but standing over the Yamaha's keyboard, it's apparent that adjacent E and F keys go down simultaneously in the left hand. Did Gould not know? Didn't he care? Did he want the minor imperfection to remain in the final take like the "wrong color thread" in a Persian rug? No one can be sure, but Zenph knows the mistake belongs in the re-performance, and it's retained.

On the other hand, a far more obvious anomaly is present on Gould's 1964 recording of Bach's Two- and Three-Part Inventions. For the sessions at the CBS studios in New York, Gould brought his beloved Steinway from Toronto. This was an instrument to which he'd made some alterations (to the action regulation, etc.) to make it—in Gould's strongly held opinion—more suitable for Bach. Unfortunately, these adjustments often

resulted in one stroke by the pianist causing *two* hits on the string by the hammer, an aberration heard quite frequently, especially during slower passages. Gould insisted that he found this "hiccup," as it came to be called, a "charming idiosyncrasy." His producer, Paul Myers, and others at Columbia were less enthusiastic but the recording was issued with the hiccups. Gould's notes for the release explained the peculiarity and promised "STAY TUNED IN: WE'RE FIXING IT." That would have meant a new recording, of course, which did not happen. That is, until Zenph had Gould play it again, posthumously, on a different instrument. Walker notes: "The piano mechanisms we use are sophisticated enough that we discovered we could, in fact, replicate the hiccup in our code. But we think we're doing what Bach and Gould intended by coding them as a single strike."

In the first decades of the last century, many famous pianists produced piano rolls and, traditionally, these have been viewed as providing important insights into the way these artists sounded. But even the ideal playback of a piano roll pales before Zenph's methodology. Compare, for example the recording of Rachmaninoff's C-sharp minor Prelude played back from a 1919 Ampico piano roll on a Telarc CD (*A Window in Time*, CD-80489) with Zenph's re-performance of the same piece, derived from a 1928 Victor record. The pianos are different (Telarc's Bösendorfer vs. Zenph's Steinway) and these are, of course, different readings of a piece the composer played hundreds of times. But the musical impression the two versions make is not at all the same. While the piano roll does provide decent dynamic variation and captures subtle tempo changes, Zenph gives much more of a sense of world-weariness and spiritual exhaustion. It's a true performance, as opposed to merely a good reproduction of a distant event.

It's not only Zenph's data-crunching that's responsible for this. Dr. Anatoly Larkin, 31, was the first performance analyst Walker hired. Born in Moscow, Larkin's father was a prominent physicist and the family traveled a good deal outside the former Soviet Union. He studied piano at the prestigious Guildhall School in London and eventually earned his doctorate in piano performance at the University of Minnesota. "It's a known fact that Rachmaninoff was extremely worried about leaving a record of his playing wrong notes, or leaving unintended slips in his performances," Larkin told me. "When you listen to his acoustic recordings, you *do* hear an occasional wrong note or strange phrasing. To us mere mortals, it's still a God-like performance. When Rachmaninoff went into the Ampico studios in the 1920s, the way they made those piano rolls was that an actual graph was generated as the performer played. They weren't punching holes—first they were drawing graphs. A guy—usually it was Edgar Fairchild, a pretty accomplished pianist himself—was sitting next to the artist. As soon as he heard something that was clearly a wrong note or a fluff, he would circle that spot on the graph. Then, with Rachmaninoff, they'd generate a preliminary punched roll they could play on a playback piano. Immediately they could say 'OK, we want to correct that wrong note, we want to even out the tempo here.' Over time, they would produce what would be the master, edited roll of Rachmaninoff as he wished to be presented to the public. It is not true, raw Rachmaninoff."

Larkin continues. "The other important piece of the puzzle that's missing is this: they only had the 6' 6" Mason & Hamlin piano to record on. Steinway, of course, is the instrument that's associated with Rachmaninoff—that's what he played in concerts and so on. We don't have an acoustic recording of those piano roll sessions to tell us the specifics of the timbre and sound of that piano. We have a *general* sense of dynamics, but it's still an unknown how far into the *forte* range he increased in a particular passage or how far into the *pianissimo* range he dropped. The holes that tell us about the dynamics are relative. There's nothing that tells us this is *exactly* the sound that Rachmaninoff was hearing as he was pressing those keys."

It was natural for Zenph to begin with keyboard recordings, both because of the existence of fine robotic pianos for playback and because the sound produced by a hammer striking a string is relatively simple to characterize. Zenph has a hierarchy of instruments that the company intends to methodically tackle over the next decade: "Anything that's struck or plucked is easier than anything that's bowed or blowed," is how Walker puts it.

Late in the afternoon, four Zenph engineers are in the recital hall working on what will be Zenph's first non-piano re-performance, a 1949 Carnegie Hall date when Ray Brown joined Oscar Peterson. A string bass leans against the wall. That instrument belongs to Dr. Ives Chor. "The bass, since it involves fingers on a string as opposed to mechanical hammers on a string, has a lot more possibilities for performative nuance," Chor, who is 39 and holds a PhD in music cognition from Northwestern University as well as a degree in jazz bass performance, explains: "Little things that the player does, and physical properties of the fingers. There are different ways that we can chop up the problem. On one level, we can talk about high-level, skeletal properties of a note like the onset, pitch, and timbral aspects. On another level, we can talk about physical gestures that the performer executes."

Chor elaborates. "Part of my job is, for any given instrument, to define the set of gestures we're interested in that produce sound. It happens that I'm a bass player. The ones we're focusing on are things like plucking, which has different parameters. Another is left hand position, which has various parameters like pressure, or y-location, which would correspond to fret (which isn't an integer value: the bass string is continuous because it's a fretless instrument). There's an x-dimension if the string is bent at all. Various physical properties of the fingertip such as the damping coefficient, the mass. Which part of the fingertip is actually placed on the string. Similarly, with the right hand plucking finger there are different properties—if there's a little bit of nail involved, if it's a fingertip, if it's the whole side of the finger. So I'm defining our gesture model for the bass, and for subsequent instruments. One approach is to make some systematic recordings where we bring in professional bass players, have them vary these properties, and make close acoustic measurements, along with videotape and different kinds of sensor, accelerometer, and video capture techniques. We'll correlate the physical gestures with the resultant sound."

So, Zenph samples the playing of a live musician and analyzes those samples to provide the raw material for a new, virtual re-performance by a famous artist. Working with Chor this afternoon is Dr. Harvey Thornburg, 36, who came to Zenph from an academic position in computer science and electrical engineering. Thornburg introduces me to the term "concatenative synthesis"—the technique of manufacturing sounds by linking short recorded samples. "What

performers do is not just one thing; it's a distribution of things. There are signature ways that they play but, to round it out, there are other things that are less common. You need all that covered if you're doing a concatenative synthesis. You don't need every note, every gesture, everything exactly covered because the synthesis engine is smart enough to piece things together. But you need the basic stylistic things covered, some examples of all the gestures." Dr. Thornburg has been developing probabilistic algorithms that will allow Zenph's engineers to work backwards from the sound to the human activity that produced it in the first place.

Crucial to successfully creating a virtual instrument is the choice of transducer used to render the data. For Ray Brown's bass, the Zenph team has settled on a single MBL 101 Radialstrahler—an interesting choice, as the radiation pattern and even the physical appearance of the loudspeaker evoke a string bass. The anonymous bassist who provided the samples was recorded with a number of different microphones positioned variously in relationship to the performer, and the engineers are also experimenting with the orientation of the MBL vis-à-vis the Steinway. They listen intently with and without the speaker's subwoofer turned on. No final decisions are made but when there's playback with both Peterson and Brown, the effect is miraculous: now *two* great players have been transported, *Star Trek* style, to Walker's recital hall.

Zenph isn't a record label and Dr. Walker is clear on this: For the company to succeed, financially and in his vision for the broad application of advanced computing techniques to musical materials, there has to be much more than recordings. Early in 2011, Zenph released its first commercial software product, a music-editing program for Yamaha Disklavier pianos. The company has also licensed re-performances for use in other musical projects. Gordon Goodwin wrote a big band accompaniment for an Art Tatum re-performance of "Yesterdays" and recorded it to sensational effect with his Big Phat Band on *Act Your Age* (Immergent 281147). A leading Japanese pop diva needed a Duke Ellington track and Walker obliged. Live concerts are another line of endeavor. While in Raleigh, I attended a theater production, a one-man show in which an actor portrayed a fictional jazz club owner recalling Tatum's life and times. He shared the stage with one of Zenph's Yamahas playing the late pianist's music. One can imagine leading chamber music organizations adding legendary artists to their piano series: Emanuel Ax one evening, Sergei Rachmaninoff on another.

There are archival possibilities, as Walker feels he can extract data to create a new performance from sources going back to around 1900. Important educational possibilities exist as well. Saxophonist Branford Marsalis is on Zenph's advisory board and, on an informational video, asks rhetorically of a student of jazz performance: "You think you're swinging? Well, you're playing with Basie's band right now. Let's hear you swing!"

Zenph's recreation of estimable old performances continues at an impressive rate; plans are to produce 25 new programs this year. (Getting them released on disc is another story, but the potential for high-resolution downloads is intriguing. *Rachmaninoff Plays Rachmanoniff* is already available from iTrax in HD surround.) A Gershwin CD can be expected soon, and Fats Waller material is "in the pipeline." Walker promises a disc of Spanish composers—Albéniz, Granados, and Falla—playing their own music. A top priority project is recording Artur Rubinstein on a Steinway Hamburg D with producer Max Wilcox, in the Academy of Arts and Letters in New York City, where Wilcox recorded Rubinstein originally 50 years ago. The process is becoming more efficient. Walker estimates that the *Goldberg* Variations cost about fourteen dollars *per note* to produce; he expects that number to come down over time to something like fourteen cents.

The Ray Brown bass recording marks the beginning of Zenph's creating re-performances of instruments other than piano. Next to the Radialstrahler in Walker's recital hall was an Acapella spherical horn speaker that Zenph's engineers were using to test an early iteration of a virtual saxophone. The reconstituted performance was that of Ben Webster and, even at this nascent stage, the technology was serving him well. Drums will be undertaken this year as well. Walker plans to try Magneplanar Tympani speakers as the transducers (he found a pair for $900 on eBay, he told me proudly), perhaps with a MartinLogan electrostatic for cymbals. The ultimate challenge will be vocal re-performances and Walker acknowledged that these could be as long as a decade away. No one fetishizes long-dead singers more than opera buffs: Imagine Caruso, Flagstad, or Melba reproduced very close to the way they really sounded.

Walker and his team of engineer/musicians have come to understand that when music was captured by the medium of the day, although the sonics may have fallen short, the clues necessary to restore the old performances to life were in there, hidden and unrecognized all these years. Ives Chor observes: "Music is not just sound. Music is also physical gesture, it's culture, it's communication. These things transcend sound. We're trying to break free of the boundaries of recording to restore some of that 'other stuff' that's in the music." **tas**