Department

Lance Gharavi: Performance Inspired Science + Technology

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***Abstract*—We caught up with Lance Gharavi after we heard of and investigated *Beneath: A journey within*, a live performance motivated by the intent to get a wider audience interested in the lithosphere and mantle beneath our feet. *Beneath* is an archetype of art-science-tech projects and Lance came to coordinating that show from a long history of art-science projects. We asked him about insights and lessons learned.**

Dr. Gharavi has been working at the intersection of art, science, and engineering through collaborating with large teams typically of artists, designers, scientists, engineers, and others to make media rich works of performance.

Like many others who had a stick-to-it-ness during the first heyday of virtual reality (VR), Lance brought the skills he acquired and fine-tuned to various projects when hired by Arizona State University (ASU) to be an artist working with digital technologies. VR was not officially on the list of his job responsibilities but as Lance suggested, "I realized it's a matter of what you call VR. Many of those themes I explored transferred well into other digital technologies."

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A Brief Anniversary of Time, a prior performance project, represents well the role he was hired at ASU to perform. "We worked with a system I call a universe in a box," he said. "The team designed the performance for ASU's flat screen planetarium—the Marston Exploration Theater that uses planetarium software called Sky-Skan. The Marston Exploration Theater software runs on a stack of ten servers and every known object in the universe is plotted in four dimensions. You can fly around in this universe anywhere you want to go—even through time. It is a way to experience the mind-bogglingly immense scope of our universe. I like to think of it as an existential-crisis-machine."

The show was a celebration of the 25th anniversary of Stephen Hawking's *A Brief History of Time* (see figure 1) with a mix of prerecorded video and live performance played out in

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Figure 1. *A Brief Anniversary of Time*. Media design by Daniel Fine. Photo credit: Matthew Ragan. (Used with permission.)

that planetarium software. As Lance observed, "Much of what I do involves media design for live performance, with some interactive data visualization."

Lance discussed the motivation of *Beneath*:

"Scientists know a remarkable amount about what exists far above us. We know the weight of the moon. We know the composition of stars in galaxies millions of light years away. But we know comparatively little about what lies just a few dozen miles below our feet. That which is beneath is our mystery and science is working to cast light on the subject. *Beneath* takes audiences on a multisensory journey to the Earth's deep interior."

"*Beneath*'s fusion of science and live performance features Christy Till, a geologist ballerina dancing catastrophic planetary cycles (see figure 2); Ed Garnero, a bass-playing geophysicist interacting with his data through trip-hop bass-lines; and Patrick Young, a belly-dancing theoretical astrophysicist embodying seismic waves. Audiences virtually visit the lab of Dan Shim, a mineral physicist who uses diamonds in startling experiments, and talk with Lindy Elkins-Tanton, the first woman to lead a NASA mission beyond the Earth's orbit."

As Lance suggests:

"*Beneath* is the product of a multiyear collaboration among a team of planetary scientists, theatre makers, performance artists, and media designers based at ASU in collaboration with animators, media designers, and artists outside of ASU, including Cloud Eye Control, Obscura Digital, and Ohio State University. These internal and external partnerships across the ASU campus and beyond have served to redefine the ways in which performance can function as both an arts-led research practice and forum for engaged learning. In both its goals and methods, *Beneath* provides a model for transdisciplinary collaboration and public outreach in science."

"The project has three central goals: to make current scientific research artful, accessible, and compelling for the public; to create new visualization tools that aid scientists in research, communication, and education; and to engage and explore new models of collaboration between artists and scientists."

"The creative team behind *Beneath* fuses theatre and science to tell a compelling story and communicate scientific research in an engaging and accessible way. It illustrates the dynamic systems of the Earth while showing the ways in which humans are connected to the immense and ancient processes of our planet."

"The best part of the collaboration was definitely working with the people (see figure 3). My main scientist collaborator, Ed Garnero, is a geophysicist and a seismologist. He tries to understand vibrations and the interior dynamics and structures of the Earth. There's a huge scientific

Figure 2. Petrologist Christy Till dances in *Beneath* at the Marston Exploration Theater. Audiences view the stereoscopic media through 3-D glasses. Choreography by Liz Lerman. Stage direction by Erika Hughes, University of Portsmouth. Systems design by Matthew Reagan, Obscura Digital; and Ian Shelanskey, BRDG Studios. Media design by Jake Pinholster, Arizona State University; Dallas Nichols; Daniel Fine, University of Iowa; Alex Oliszewski, The Ohio State University; Miwa Matreyek; Boyd Branch, University of Kent; and Elora Mastison, Arizona State University. Sound design by Stephen Christensen, Arizona State University. Photo credit: Tim Trumble. (Used with permission.)

project called *EarthScope*, one of the largest project ever funded by NSF, and they are rolling these seismometers all across North America along with permanent ones mounted all over the place—to try and get a 3-D picture of the Earth's interior. We took that data and created a 3-D model of the Earth's interior based on an enormous spreadsheet of several terabytes of numbers. Ed is also a semiprofessional bass player. Through our software, he uses his bass to 'play' his data, lighting up the different parts of the Earth's interior depending on pitch (see figure 4)."

"Christy Till studies rocks and magma; she is also a former professional ballerina and so dances expressively in the performance. Patrick Young is a semiprofessional belly dancer, who used his body in the show to demonstrate how seismic waves work. For the scientists who were live in the performance, the process was deeply moving. It was a way of bringing together different aspects of themselves."

When we asked about his opinions on sonification, Lance said:

"I love sonification of data but you often don't know what you are hearing. We took the sounds from an earthquake and increased the pitch so you could hear it. We turned out all the lights in the theater so people could experience this earthquake wave in the dark for a minute. It's intense and intimidating, rather like someone banging on a trashcan. You feel the vibrations in your body."

"When we can ask questions of scientists that they weren't expecting, or hadn't thought of it that way, we can help. Science is not just a bunch of data or a lot of numbers. Science is stories, and thus, it depends on metaphor. That's what we do as artists, many of us, as storytellers—we deal in metaphor. Finding new metaphors with stories to tell is a contribution to science."

"Some artists just use the outputs of science as fodder for art work. Some translate science for the public (as in *A Brief Anniversary of Time*). Some get involved explicitly trying to show data in new ways. On very rare occasions, working with scientists, artist collaborations can lead to advances in the science. That is always a useful goal. I have various projects where that is really a big focus, having gained the trust of scientists through a longer term collaboration."

Lance's current work with Ars Robotica speaks well to the potential of shifting toward a partnership of artists and scientists pursuing science together. As Lance explains:

"The focus of the Ars Robotica initiative is advancing robotics through art and design. I initially worked with a robot called Baxter created by Rethink Robotics, a company that makes anthropomorphic robots. I partnered with ASU's Autonomous Systems Technologies Research and Integration Laboratory (ASTRIL), and it was

very much about trying to get a robot to fill the needs of the production we were creating (see figure 5). We built some software and an interface to control the robot and it was like an anthropomorphic remote controlled car. At the end of it, Srikanth Saripalli, the lab's Director, asked, 'Can we keep working together? Because working with you has helped advance our research.' With that Ars Robotica was born."

"I saw that many artists will take the science and bend it to the purposes of the art they are making. I thought, 'What if we put the interests of the research first and then make art to support the research goals?' That's what Ars Robotica does. For instance, now we are working to design a testbed for swarms of driverless cars and remotely operated vehicles."

"Initially I said to them, 'you can get your undergraduates and graduate students to build models for this work. You can go to the nearest train store and pull out buildings and stuff. Why come to an artist?' They were like, 'we don't know.' I said, 'that's a totally acceptable answer. We can figure that out together.' And so the project will be simultaneously a test bed, a laboratory, but also a performance and art installation. It took a period of trust and working together before we found a common process for advancing explicit goals to advance the technology and science."

Figure 3. *Beneath* team at work. From left: Lance Gharavi, Ian Shelanskey, and Ed Garnero discuss ways of visualizing and sonifying vast amounts of seismic data to reveal the formations of the Earth's deep interior in 3-D. Such visualizations will have a life beyond the performance as tools for scientists. Photo credit: Tim Trumble. (Used with permission.)

Figure 4. In *Beneath*, Heather Lee Harper, Lance Gharavi, and Ed Garnero perform a trip-hop spoken word number about the vibrations in the Earth's interior. Photo credit: Tim Trumble. (Used with permission.)

Lance's work with robotics now focuses on creating a context or a site for science. "But also a performance event, in the case with robots, that wants art to do more. It has to serve a technical and utilitarian function."

The hard part as a liaison is figuring out what is the best way to inject the practice and training of art into serving the science. Lance adds:

"With *Robotopolis*, an upcoming project, one of the practical challenges was figuring out how to fulfill the needs of the robotics lab while doing

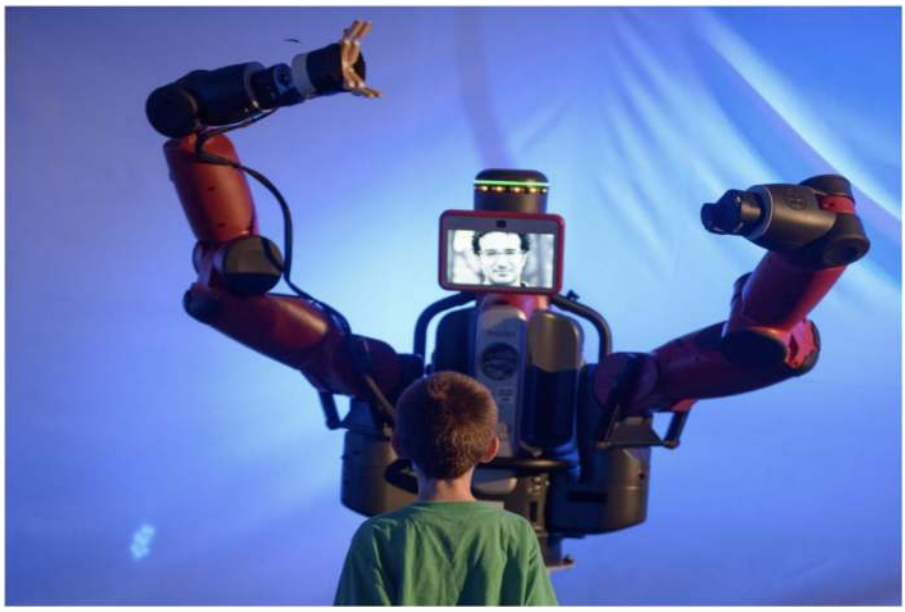

Figure 5. Baxter performing in *The Mirror*. The ASTRIL lab that used Baxter has moved with its Director to another institution. Ars Robotica has now teamed with the Center for Human, Artificial Intelligence, and Robot Teaming, specifically to work with swarm robotics. Instead of a single robot, they coordinate swarms of robots, like bees, in the ground, air, or water. The robots can be large or tiny, but they work together to perform tasks. Photo credit: Tim Trumble. (Used with permission.)

Figure 6. Brian Foley in *Immerge*, a large-scale transdisciplinary work of digital performance, a dramatic myth on the free movement of data and creativity. Featuring architectural projection, virtual life forms, and other media. Lead artist: Lance Gharavi; media design: Jake Pinholster and David Tinapple; production design: Anastasia Schneider, Brunella Provvidente, and Adam Vachon. At the Emerge Festival 2012. Photo credit: Tim Trumble. (Used with permission.)

the things that art needs to do. How am I going to create something that I feel pulls all my triggers as an artist on the way to constructing something useful for the lab?"

"*Robotopolis* is a city for robots. We plan on taping out the ground plan the first of the year and once we confirm the ground plan is going to work for our needs, we'll move forward with finalizing architecture and other aspects and start the build and complete the process of media design. There is a whole aspect of media design in this because we are going to hit the city from several directions with projections and map those onto all the buildings—quite a complex projection mapping task."

Another project in the works worth tracking as it advances is *Port of Mars*. Lance suggests:

"Some of the biggest challenges of human space exploration aren't technological. They are social. How can we best sustain healthy human communities in space? What social systems and structures do we need? We have created a project to find solutions. It is a game-based social science experiment called *Port of Mars*. In the game, all players are members of the first Martian community and they have to support the goals of the community in surviving while also pursuing their individual goals. All the behaviors of the players are monitored and tracked. We will analyze their behavior to see what kinds of things lead to success and what leads to failure. What systems and processes will people invent to get along?"

"We go into experiments in February and March. The experiments were designed by a couple of applied mathematicians, Marco Janssen and Marty Anderies, doing work in the social sciences, especially commons issues. Also onboard are game designers like Michael Yichao of Riot Games, plane- tary scientists like Mars expert Tanya Harrison, visual artists like Titus Lunter, and many other specialists. These relationships will lead to useful contributions to the science, and also something fun and artful."

"The term 'commons' refers to any resource shared by a group. Earth's ecosystem is a giant commons, for instance. The great thing about Earth is we have such abundant resources. But now we are bumping up against some serious ceilings—climate change, mass extinctions, etc. If we send people to Mars, they will be much more dependent on shared resources and those resources will be much scarcer; there's a very narrow margin for error. Before we spend the billions of dollars and put people's lives at risk, we had better learn how to navigate commons dilemmas in such a hostile environment. *Port of Mars* is about finding solutions to such dilemmas."

Collaborative projects involving the artistic community and the sciences, pursuing common ground and bridging professional norms, have required a lot of patience historically, as well as the ability to bridge languages (see figure 6). In Lance's case:

"People always ask me, 'How do you manage collaborations like these across such diverse disciplines?' It's true there are different disciplinary cultures, different languages, goals, and tools. Part of what's exciting about such work is that difference. It's a source of allure as opposed to a problem. When you do interdisciplinary work, gathering people with such different skills and knowledge, everyone is a wizard to everyone else. But really, it's not so difficult. We are all passionately curious. We are all skilled in asking questions, seeking answers, and solving problems. We are all trained to work with a team toward a goal based on limited input, with limited time and resources. I find the infectious sense of wonder and excitement about the questions and challenges bonds us and makes our differences feel negligible."

"Mostly, I am interested in big stories and big ideas. Science has them. Art gives them breath."

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