



The Sound of Science

When seeing isn't enough
for believing

Composers inspired by the cosmos—the Kronos Quartet, Brian Eno, Mike Oldfield and others—have produced interesting, if sometimes cringe-worthy, music. Now, science is adding a new wrinkle to spacey tones, using sound to represent information that is typically communicated visually.

The field of “sonification”—the translation of non-audible data into sound—has been around for decades. (Think of the Geiger counter.) Even so, as recently as 1997, it was described in an NSF report as being “in a formative stage.” And then it began expanding: Attendance at the annual conference of the International Community for Auditory Display (ICAD) has almost doubled since then.

UC, Berkeley's Space Science Lab (SSL) is one group that's at the vanguard of finding new ways to represent data. Having developed an “iconic” sonification system, scientists at SSL are getting ready to analyze data from a pair of spacecraft, called STEREO A & B, that will study coronal mass ejections and solar winds. Each category of data collected by STEREO (like different energies of solar

particles, or the rate at which they hit a detector) is assigned a sound quality (like a note on the scale, or degree of volume), with each instance of a particular data point producing its respective sound quality.

Roberto Morales, a PhD student at Berkeley's Center for New Music and Audio Technology, wrote computer programs that turn STEREO's data into sound, to be analyzed by the SSL physicists. Morales' sonification tools will help focus their attention on certain types of events that merit further investigation. Laura Peticolas, a physicist who oversees Morales' work, says the algorithms will give the scientists “flexibility...really any color graph can be displayed and then listened to, which is rare in sonification.” Janet Luhman, who will be interpreting STEREO's data, said her team will now have “the opportunity to hear the spatial and temporal dimensions of space weather together... If I listen to the data I may be better able to sort it out.”

Indeed, sonification's adherents say that hearing data through iconic sonification, rather than just seeing it, can enhance understanding and enable the recognition of patterns in information that, displayed visually, would look like a confusing jumble. “The human auditory system is the best pattern-recognition device that we have,” said Bruce

Walker, a computing and psychology professor at Georgia Tech and president-elect of ICAD. “And when you're trying to figure out patterns in any complex data set, it turns out to be very effective to use sound in order to determine those patterns.”

Cognitive scientists agree. Auditory representation enables recognition of “certain patterns...that you wouldn't be able to see in the [visual] sense,” said Marty Woldorff, associate director of Duke's Center for Cognitive Neurosciences and an expert in sensory perception. Vision tends to work best for spatial data, naturally, but it's been established that we process temporal information better by hearing it. For instance, abnormal

Sonification can enhance understanding of information that would otherwise look like a confusing jumble.

patterns in EEGs are better grasped by ear than eye, allowing for a quicker diagnosis of epilepsy and other disorders. And when it comes to perceiving data, Woldorff added, more can equal better: “If auditory and visual stimuli are synchronously presented...you get enhanced processing.”

In a separate project, Morales also alters the sounds to “write” his own music. Last year, he composed an orchestral suite, “Turning Points,” that was based in part on solar winds. He likes to “play around,” turning the data into a piece with “the aesthetics [he's] looking for.”

Whatever the relative merits of space-based music (Rush's *2112*, anyone?), STEREO may hold promise both for sonification and for space science. Peticolas says she looks forward “to find[ing] out if we discover anything new in the solar wind from listening to the data rather than looking at it.” —Britt Peterson



06.4 “HEY, SQUEAKY, OVER HERE”

Everyone knows that dolphins are smart and cute (and are money-factories for aquariums); now scientists have established that some can call one another by name. A paper in the *PNAS* reports that bottlenose dolphins in Florida respond to whistling calls even when signature vocal features were removed. This indicates that the recognition came from the sound itself, not the animal making it.