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Solar Wind Sonification

The Solar and Heliospheric Research Group at the University of Michigan is creating sonic translations of ACE data through a relatively new technique known as sonification, which allows one to convert data into sound and hear complex interactions between multiple data parameters. The team was able to perceive events such as coronal mass ejections, and subtler features of the solar wind were distinguishable after some training.

Initially, 2-hour averaged solar-wind parameters and charge-state distributions from SWICS were sonified with a custom algorithm in the Max/MSP computer-music scripting language. Data points included He++ density and velocity, average carbon charge state, solar wind type, He/O, and the prevalence of carbon charge states 4+ 5+ and 6+. In this iteration <http://www.youtube.com/watch?v=n_VyZi0fED4>, the sweeping wind sound is generated by both He++ density and speed. The speed parameter controls the cutoff frequency of a band-pass filter, which causes the "whooshing" noise that sweeps up and down. The use of filtered noise creates a sound reminiscent of terrestrial wind phenomena. A basic vocal ambience is created with 3 distinct layers that each correspond to a charge state of carbon. The prevalence of one charge state over the other, as determined by the distribution ratio, is used to modulate the loudness of each vocal layer. Solar wind type is the most readily discernible feature in this sonification. During a CME, the reverb quickly swells to a much higher volume before slowly attenuating back to the original volume, which creates the feeling of a sudden expanse. A Low-Frequency bass tone was generated with a saw-tooth waveform that traveled algorithmically between a predetermined group of pitches. The change in pitch happens once every half sidereal Carrington rotation; two changes in pitch mark one full sidereal Carrington rotation (25.38 days).

Although this sonification effort is still in its early stages, the team has already successfully utilized auditory data analysis to reveal new insights into the boundaries between solar wind types. Custom-designed software tools that enabled researchers to build and vary sonifications in near real time, much like is currently done with visualizations, could potentially improve scientific understanding of the data and lead to new ideas for exploration. In addition to this work, Alexander is currently creating a full orchestral translation of ACE data as a section of a larger piece entitled The Quantum Symphony, which will premiere in 2012. This work is in collaboration with Marty Quinn of the Design Rhythmics Sonification Research Laboratory, and American Composer Libby Larsen.

This item was contributed by Robert L. Alexander, Jason A. Gilbert, Enrico Landi, Susan T. Lepri, Jim M. Raines, and Thomas H. Zurbuchen of the Solar and Heliospheric Research Group at the University of Michigan. Address comments and questions to jagi@umich.edu.
See http://www.srl.caltech.edu/ACE/ACENews_Archives.html for earlier ACE News items.

Additional Links:

4-Minute Sonification of ACE Data (2003). Halloween events are from 2:54-3:05: <http://www.youtube.com/watch?v=n_VyZi0fED4>

Sonification Video with Tribal Drums: <http://www.youtube.com/watch?v=kryCbfRJCyk>

The Solar and Heliospheric Research Group: <http://solar-heliospheric.engin.umich.edu/>

University of Michigan Video Podcast: <http://ns.umich.edu/podcast/video2.php?id=1210>

Public Radio Interview – The Sound of Solar
<http://www.loe.org/shows/segments.htm?programID=10-P13-00010&segmentID=7>

Solar Symphony Generated from ACE Data (2003 - entire year):
<http://www.robertalexandermusic.com/Solar_Sonification/Solar_Symphony_ACE2003.mov>