



International research networks enable a creative union of science, technology and art

Predicting volcanic eruptions to help save lives is an enduring problem that continues to challenge researchers. One method, 'data sonification', aims to solve this puzzle, and has also given birth to a unique collaboration between science, technology and the arts in a milestone dance performance entitled *The Mountain*. Performed by CityDance Ensemble of Washington DC to raise awareness of climate change, the music for *The Mountain* was derived from seismic data collected from active volcanoes: Mount Etna in Italy, Mount Tungurahua in Ecuador and the Mountains Mayon and Pinatubo in the Philippines.

The seismic data were converted into sound using the data sonification process, developed by Dr Domenico Vicinanza of networking organisation DANTE, UK. Though originally designed to help predict volcanic eruptions, Domenico immediately saw the musical potential.

"As a scientist it was my priority to develop tools to help us predict eruptions and ultimately reduce the loss of lives," said Domenico. "But as a musician and artist too, it was a natural step for me to apply these sounds to the arts."

Data sonification demands high-bandwidth connectivity

Converting seismic data into sound waves through the sonification process involves substantial computer processing. A one-second seismic sample generates 120 MB of data, filling a DVD after 40 seconds or a CD after just six seconds. This amount of information, combined with the complexity of the sonification process, requires high-bandwidth capacity and advanced grid-computing platforms.

"Using sounds to extract similarities that could signal an eruption makes perfect scientific sense," said Roberto Barbera of the University of Catania and the Italian National Institute of Nuclear Physics (INFN). "However the scale of the operation of data sonification is immense and high-bandwidth networks and computing grids have been integral to the success of this project."

Global, multi-disciplinary collaboration

In 2006 scientists Federico Domínguez and Carlos Monsalve at the Escuela Superior Politécnica del Litoral (ESPOL) in Ecuador started to collaborate with the researchers in Italy to compare the seismic data of Mount Tungurahua and Mount Etna via RedCLARA and GÉANT.



The Mountain, performed to music derived from seismic data

Connect – Communicate – Collaborate

The world is criss-crossed with high-capacity data-communications networks, connecting and serving research and academic institutions across the globe. Amongst these are GÉANT serving Europe, EUMEDCONNECT2 for the Mediterranean region, TEIN3 in Asia-Pacific and RedCLARA in Latin America.

Separate from the public Internet for reasons of security and performance, these networks make an enormous practical contribution to research in a wide variety of areas – saving lives, building knowledge and enabling real-time collaboration between scientists all over the world.

Through stable and reliable high-bandwidth connections, the GÉANT, TEIN3, and RedCLARA networks provide the connectivity that enables the sonification process.

It was at this point that the extension of the sonification project to the arts began; music based on seismic data from Mount Tungurahua was performed at the launch of Ecuador's National Research and Education Network (CEDIA), and hence the concept of 'singing volcanoes' came into being.

Word soon spread to the United States and following coverage on a US radio interview, Paul Emerson (artistic director and co-founder of dance company CityDance Ensemble) expressed his interest in a 'volcano music' score for a performance being developed by Philippine choreographer Jason Garcia Ignacio, which aimed to raise awareness of mankind's impact on the climate.

Jason's Philippine background led to collaboration with Jaime S. Sincioco of the Philippine Institute of Volcanology and Seismology (PHIVOLCS), who was researching Mount Mayon and Mount Pinatubo. The story had now turned full circle, and the artistic involvement had fostered further scientific collaboration made possible by research and education networks.

Premiere marks international collaboration

The Mountain premiered to critical acclaim at the Kennedy Centre of Performing Arts, Washington DC, in September 2009. It marked a unique creative union between science, technology and art, amid

“ To be granted permission to choreograph The Mountain to music made from the four volcanoes was a huge honour for us at CityDance Ensemble. Aside from the fact that the music is directly from the mountains, our environmental message aligns perfectly with the substantial impact these volcanoes have on humanity and our habitats. It is a very powerful metaphor. ”

Jason Garcia Ignacio,
Choreographer/Performer,
CityDance Ensemble,
Washington DC.



“ Mount Mayon has erupted 48 times in history and it is our job to predict when an eruption will take place to save lives. Without the South East Asian network TEIN we wouldn't have access to data sonification resources in Europe that has enabled us to join forces with Mount Etna and Mount Tungurahua researchers. ”

Jaime S. Sincioco,
Officer-in-Charge,
Volcano Monitoring & Eruption
Prediction Division, PHIVOLCS,
Philippines



a desire to raise public awareness of global warming. Performed in North America to music inspired by volcanoes on three different continents, it also marked a significant international research collaboration aimed at saving human lives, enabled by the GÉANT network and its connections to other research and education networks around the world. For more information on The Mountain and to see video of the dance, visit: www.volcanodance.org

Grid computing is a form of distributed computing whereby a 'super and virtual computer' is composed of a cluster of networked computers acting in concert to perform very large tasks. This technology has been applied to computationally intensive scientific, mathematical, and academic problems. Grid computing is heavily dependent on the high-bandwidth connectivity offered by GÉANT and other research networks around the world, in order to carry such large amounts of data between networked computers at high speed.

Advancing towards volcano signature tunes

Through their efforts researchers have started to identify correlations between seismograms and volcanic activity, including eruptions. As their work continues and more volcanoes are included in the project, they are confident that their aim of discovering volcano signature tunes will come closer to fruition.

Extending the Use of Sonification

Sonification is now being recognised as a useful tool in many other research areas and the range of data which can be analysed is unlimited. Its use for and by the blind and visually impaired is of particular relevance, along with its application to studies of oxygen levels in water. Market share fluctuations add another possible dimension. The sonification process is made available to users on-line through the Genius interface at: <https://glite-demo.ct.infn.it/>

For more information:

DANTE - www.dante.net

GÉANT - www.geant.net

RedCLARA - www.redclara.net

TEIN3 - www.tein3.net

CityDance Ensemble - www.citydance.net

The Mountain - www.volcanodance.org

