Sonification for geoscience: Listening to faults from the inside

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Here we investigate the use of sonification for geoscience by sonifying the data generated in computer models of earthquake processes. Using mainly parameter mapping sonification, we explore data from our recent 3D DEM (discrete element method) models where granular debris is sheared between rough walls to simulate an evolving fault (e.g. Mair and Abe, 2011). To best appreciate the inherently 3D nature of the crushing and sliding events (continuously tracked in our models) that occur as faults slip, we use Ambisonics (a sound field recreation technology). This allows the position of individual events to be preserved generating a virtual 3D soundscape so we can explore faults from the inside. The addition of 3D audio to the sonification tool palate further allows us to more accurately connect to spatial data in a novel and engaging manner.

During sonification, events such as grain scale fracturing, grain motions and interactions are mapped to specific sounds whose pitch, timbre, and volume reflect properties such as the depth, character, and size of the individual events. Our interactive and real-time approaches allow the listener to actively explore the data in time and space, listening to evolving processes by navigating through the spatial data via a 3D mouse controller. The soundscape can be heard either through an array of speakers or using a pair of headphones.

Emergent phenomena in the models generate clear sound patterns that are easily spotted. Also, because our ears are excellent signal-to-noise filters, events are recognizable above the background noise. Although these features may be detectable visually, using a different sense (and part of the brain) gives a fresh perspective and facilitates a rapid appreciation of 'signals' through audio awareness, rather than specific scientific training. For this reason we anticipate significant potential for the future use of sonification in the presentation, interpretation and communication of geoscience datasets to both experts and the general public.