

Pam Cuce  
Vassar College  
BBSI Proposal

## Sonification of A Complex Agent-Environment Interaction

### Background:

Sonification is an interdisciplinary technique scientists have used as a new tool for studying large sets of data - it is the use of non-speech audio to convey information. While it has been around for quite some time (for example, the well-known Geiger Counter), currently it has evolved for new applications. It has emerged with great potential for augmenting classical data analysis. These classical analyses are mostly visual and their dissection is generally long and tedious. Sonification offers an alternative process that might prove more efficient because "it has been argued that properly designed sonifications have the potential to increase the amount of data a human can simultaneously process beyond that achievable with traditional visual display technology (Scaletti and Craig, 1990)." Further, it is easier to pick up tiny perturbations in musical patterns than in random visual ones. Audio data has many more nuances than visual data such as pitch, duration, volume, vibrato strength, vibrato speed, brightness, and roughness and all of these things could potentially carry some form of information. In the area of complex systems, sometimes it is virtually impossible to be able to visualize the system and here sonification can be seen to help tremendously.

### Method:

Two Rugwarrior platform robots will be used that rely on subsumption architecture. Both robots would be equipped to relay wireless information and produce sound. The emphasis would be on using music as a state indicator of what is happening between the agents and the environment. Agents (Robo1 and Robo2) would be placed in complex environments with various interactive elements. Interacting with a chosen object in the environment would cause some form of musical output from Robo1 whose purpose would be to alert Robo2 to the state of the environment (for example, what object has been found by Robo1). Then, a response would be emitted from Robo2 as a form of communication that the environmental information has been received. Basically, both traversing the complex environment and secondary confirmation of communication between the robots would provide stimulus for musical response. Sound would signify state change as well as producing discernible patterns over time for analysis. Music would be the emergent phenomenon based on the activity in the complex environment and relaying that activity. After letting the robots interact with their environment, the resultant music would be recorded. The idea is that one could tell what had gone on in the agent-environment interaction without actually seeing it first hand. Moreover, they would be able to pick up patterns in robot interaction based on musical patterns. This would be a useful tool for others to analyze system-environment states and interactions without being there first hand to witness the experiment. The music would be the shorthand of all the environmental interactions. Furthermore, it would be interesting to design environments specifically that elicited a specific song like "Take me out to the Ballgame". The idea would be to think of specific environments that would generate specific types of songs (like songs in a minor key). Another interesting phenomenon is that tiny perturbations in the environment would end up producing a whole new emergent song. Learning will be a key component of this sonification project. Initially, the robots will only be able to produce very simple notes but eventually after receiving feedback from the environment more complex music will be produced.

#### Results:

Eventually, a robot performance piece will be arranged and presented. Possibly, an improvisational piece will also be presented. The use of sonification in data analysis will be evaluated.

#### Funding:

BBSI funds will be allocated to robot pieces and any supplemental material that is needed for me to learn more about the project (like C++ manuals)

#### References

Scaletti, C., & Craig, A. B. (1990). Using sound to extract meaning from complex data. In E. J. Farrel (ed.), *Extracting meaning from complex data: Processing, display, interaction* 1259, 147-153. SPIE.