Human Auditory Event Formation

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The Problem: Auditory event formation is our ability partition a sound stream into pieces identifiable with separate sound sources. Examples include hearing individual instruments in an orchestra, or isolating a person's speech in a party noisy with other converstations. In the vision domain the parallel phenomenon is our ability to segment a scene into objects.

Motivation: An effective event formation method would greatly help any speech recognition system by pruning out most of the noise, i.e. the sounds coming from interfering sound sources. It would also make it easier to learn in noisy enviroments.

Previous Work: There is overwhelming experimental evidence that the most important factors that provide us with cues as to what parts of the signal belong to each of several sound sources are the following: The acoustic events in the sound stream that can be attributed to a particular source

1. have simultanous onset/offset,
2. have simultanous movement of harmonics and frequency components,
3. have a common pitch,
4. havea common percieved source location, i.e. equal interaural time and loudness difference.

There have been several computational models attempting to model human auditory event formation [2]. They employ crosscorrelation analysis to extract the interaural time and intensity difference, as well as the common pitch and frequency variation. Onset and offset time is determined by simple filtering operations.

Approach: I modify a technique from neuroscience described in [1]. In a nutshell, information is carried by the temporal firing pattern of spike trains of groups of neurons, and recognition or event formation is achieved through synchronization of the spiketrains coming from subgroups of these neurons.

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References:

[1] J.J. Hoppfield Carlos D. Brody. What is a moment? cortical sensory integration over a brief interval i-ii. *Princeton University*, page http://neuron.princeton.edu:80/moment/www/Organism/index.html, December 2000.

[2] Bernard M. Mont-Reynaud David K. Mellinger. *in Auditory Computation: Scene Analyis, pages 271-331*. Springer, 1996.