Phase-locked onset detectors for monaural sound grouping and binaural direction finding.

Locating sound sources is an important task for animals. IID\textsubscript{s} and ITD\textsubscript{s} are normally used to provide information about the instantaneous direction of sound received at the ears. In a reverberating environment, this may differ from the direction of the sound source. However the IID\textsubscript{s} and ITD\textsubscript{s} always provide information about sound source direction at onset, since onsets always arrive from the shortest, direct path. Binaural recordings were filtered using a gammatone filterbank, converted to a phase-locked spike code, and passed to a leaky integrate-and-fire neuron through a rapidly depressing synapse. This provides a phase-locked onset detector in each bandpassed channel. Nearly coincident onsets from different channels in each ear were grouped. IID\textsubscript{s} and ITD\textsubscript{s} were computed when grouped onsets in both ears occur at almost the same time. ITD\textsubscript{s} were converted to azimuth geometrically: IID\textsubscript{s} were converted using the impulse response at each ear. The results show that even in a reverberating environment, sound direction can be found from a single onset. Wideband and long sounds provide better results. Multiple sound sources can be accommodated. The system exhibits the precedence effect since a second onset (without intermediate offset) will be ignored because the depressing synapses will not have recovered.