

# Vector Noise Cancellation

## Noise Rejection Capability of Multiple-Microphone Earpieces

**Problem:** Develop a system employing an array (2 to 8) of earpiece microphones to sense user's speech with high fidelity and simultaneously reject environmental noise using vector noise cancellation techniques.

### Description

Engineers in the communications and automotive fields are focusing a great deal of attention on voice-activated control technology. The automotive industry is currently adopting voice-activation controls to do simple tasks such as controlling audio signals (radio, CD player, phone) along with temperature, GPS controls and others. Regardless of the use of voice-activation, the usefulness of the application very much depends on the ability of the system to distinguish the user's voice command from the ambient background noise and external voice sources. Today, DSP technology is used to design effective background noise cancellation hardware allowing the use of voice-activated commands.

### Solution Design

Background noise cancellation has been accomplished in a variety of ways. One technique, spectral subtraction, monitors the amplitude of the measured sound to determine whether the user is speaking. When the user is not speaking the background noise is measured and stored. This stored noise signal is subtracted from subsequent noisy speech signals eliminating much of the corrupting background noise. This has been a fairly effective technique but is limited to background noise that is fairly constant and at relatively low levels.

A more effective technique requires the user to wear an array of microphones on a headset. As the combination of voice command and background noise is simultaneously measured, the time domain signal is converted to the frequency domain. Now each measurement from each microphone will have a specific phase and amplitude relationship. In particular, the user's voice signal has a particular known phase and amplitude relationship. Armed with

this knowledge, digital signal processing (DSP) technology is used to remove the noise from the frequency domain signals and to convert them back to the time domain. The advantage of this method, using an array of microphones, is that the user's voice can be distinguished from noise originating from any direction. Also, rapidly changing and impulsive noises (other voices, cars honking, etc.) can be removed from the measured voice signals, something

### Real World Application

SDL has worked with a major communications company to develop a vector noise cancellation system for consumer products. Using SDL's **DSPdeveloper™**, and ADI SHARC DSP hardware, a system was developed allowing the user to issue voice commands in the presence of background noise, both at high levels and impulsive. This technology has a wide variety of applications and will be an effective tool to develop more precise and clear communications and voice command technology.



Prototype Design of Microphone Array

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