Piezo Film Audio Waveform Library

R H Brown, updated 11 Oct. 99

Introduction

Piezo film sensors are able to detect vibration or dynamic pressure signals across an extremely broad bandwidth, from sub-audio (down to 0.1 Hz in some cases) to high ultrasonic (>100 MHz). In many cases, however, the signals of interest lie within the audio band. The author has captured a number of interesting examples, using a very basic acquisition system: the internal sound card of a desktop/laptop PC, used in conjunction with a versatile waveform editing program and, in some cases, an additional preamplifier to provide some signal conditioning.

These waveforms are presented below, in .WAV file format, and may be played back using any "media player" such as Winamp or Windows Media Player, although the author recommends the GoldWave 4.02 program (shareware, download from www.goldwave.com). GoldWave allows visual inspection of the waveform in time and frequency domains, and a wide range of filtering and processing options to edit the signals.

The .WAV file format is a standard format for encoding and presenting audio information, and is used or recognised by virtually every soundcard and associated software.

Although the wave files are presented "just for fun", they serve to illustrate some unique possibilities of piezo film as a contact microphone.

THE FILES NEED TO BE IN THE SAME DIRECTORY AS THIS DOCUMENT FOR THE LINKS TO WORK PROPERLY

ant.wav	Listen to the sound of an ant, scurrying over a piezo film sensor supported at each end. Waveform is in real time, but processed to enhance the sound of the "footsteps".
window.wav	Piezo film was bonded using adhesive tape to both the outside and inside surfaces of a double-glazed window, and used to record the author's voice in the room. This stereo recording can be split to play back each channel separately. A very slight delay between the channels corresponds to the time delay through the air gap between the panes of glass.
pen.wav	A piezo film sensor was bonded using adhesive tape to a felt-tip marker pen. Three normal signatures were written, followed by a similar name with different first initial. The difference in this fourth "signature" can be clearly heard. Acoustic signature verification?
shot1.wav	Impact of an airgun pellet on steel plate. The piezo film sensor was bonded to underside of plate. This signal sounds interesting when played back slower than real-time.
shot2.wav	Another airgun trial - this time, the sensor was bonded to a card target, and the pellet passed straight through. You hear the sound of the card rupturing.
fizz.wav	Listen to the sound of mineral water being poured into a glass, detected by a film sensor bonded to the outside.
road.wav	The sound of a car passing over a piezo traffic sensor buried in the roadway.
fan.wav	The author's PC has a noisy cooling fan on the power supply, which "settles down" after a few minutes. Presented here is the transition from noisy to normal running, captured by a piezo film sensor bonded over the fan grille.

Data Acquisition using PC Sound Card

Pros:

- standard equipment on virtually all PCs - low-cost option if not fitted
- very high dynamic range (16 bit sampling typical, gives theoretical 90 dB bipolar range, better than many digital storage oscilloscopes)
- "depth" of storage (length of time record) limited only by available disk space
- flexible sampling rate, single or dual channel acquisition
- range of standard waveform storage formats, including compression

Cons:

- low input impedance (50K ohm for line input) - piezo sensors may need buffer/pre-amp
- limited bandwidth - 20 Hz (fixed) to 20 kHz (approx max)
- limited acquisition mode/trigger options
- limited control over input sensitivity (typically Microsoft Master Volume)

GoldWave 4.02 Waveform Editor

Pros:

- powerful, intuitive editing package, allows playback of acquired waveform as audio signal through PC speakers
- low cost (shareware - unregistered version limited only in number of processing steps possible, $40 approx to register)
- compact - program and associated files require only 1.67Mb disk space (excluding data)
- digital signal processing includes high/low/bandpass/bandstop filtering, graphic and parametric equalisation, compression, noise reduction
- FFT spectrum, spectrum bar, spectrogram display of waveform data
- playback rate variable from 0.1X to 4X with single slider control
- direct waveform editing of individual samples
- wide range of import/export file formats, including ASCII/DOS text (to/from spreadsheets)
- compatible with any sound card

Cons:

- FFT trace is instantaneous, and cannot be averaged or saved