

J-DSP: An Online DSP Laboratory

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Also core software used in an NSF CRCD 2004-2006

Overview

- J-DSP blocks to generate, process and understand analog signals.
- Application of J-DSP to courses in Arts, Media and Engineering Department at Arizona State University.

Analog Signal Generator

- Parameters
 - Signal Type – Sine, Square, Triangular, Exp.
 - Amplitude
 - Analog Frequency
 - Phase

- Output: A string symbolic representation of the chosen signal.
 - For e.g. - $4\sin(50t + 60)$ or $16\exp(-20t)$

Analog Signal Processing

- Linear combination of signals

ASU Arizona State University *Analog Signal Processing (Contd.)*

- Sampling and Quantization

The screenshot displays two LabVIEW sub-blocks. The left block, 'Sample and Hold', shows a signal being sampled at a frequency of 2000. Below it is a plot of the sampled signal. The right block, 'PULSE CODE MODULATION (PCM)', shows the signal after quantization. It includes parameters for SNR (10log) and the number of quantization bits (16). A plot below shows the quantized signal.

ASU Arizona State University *Future Work*

- Extend the algorithm to allow the user to enter any expression mathematically, automatically parse the expression and generate the corresponding signal.
- Expand the current library of blocks to include more blocks that help understand the behavior of analog signals.

ASU Arizona State University *Arts, Media and Engineering*

- Sound Sensing and Analysis
 - Algorithms to extract important features from audio, speech signals or environmental sounds based on their content.
 - Some examples of common features -
 - Pitch
 - Temporal Energy
 - Harmonicity
 - Spectral Centroid
 - Mel Frequency Cepstral Coefficients.
 - Tonality Index

ASU Arizona State University *Pitch Estimation*

- Track the fundamental frequency or pitch of a given frame.

The screenshot shows a LabVIEW interface for pitch estimation. It features a 'Long Signal Generator' block with settings for 'Input Signal' (Music), 'Gain' (1.0), and 'Framesize' (256). A 'Signal Preview' plot shows a waveform. The 'Pitch Estimation' block displays 'ESTIMATED PITCH VALUES' for different methods: AMDF Method (66), Autocorrelation Method (65), Open-loop Pitch Method (65), and Closed-loop Pitch Method (63.3333).

Harmonicity

- Probabilistically measure whether the given frame exhibits a harmonic frequency structure or not.
- Harmonicity averaged over a number of frames is an important feature to study environmental sounds.

Spectral Centroid

- Indicates the location of the 'center of mass' of the spectrum.
- Perceptually gives an impression regarding the 'brightness' a given sound.

Tonality Index

- Used in psychoacoustic models to determine whether a given sound exhibits a tone-like or noise-like characteristic.

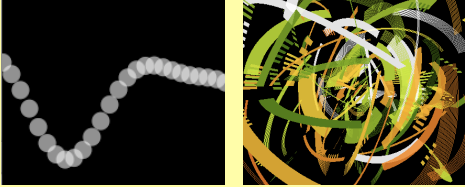
Temporal Energy





- Calculate the average energy of a given frame. Use threshold to mark the frame as voiced or unvoiced.

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100P
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Future Work

- Integrate *J-DSP* with *Processing* to create interactive simulations and programs to aid interdisciplinary students in AME.





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