SigLib The Portable DSP And ML Library

NUMERIX

The SigLib™ ANSI C source Digital Signal Processing and Machine Learning library has been designed to provide the highest level of functionality and portability. SigLib contains over 1000 base functions and over 56,000 lines of code, it is fully supported with example programs and documentation. SigLib has been fully coded in ANSI C for maximum portability and it has been written to make maximum use of modern optimisation techniques. SigLib is always ported to the latest generations of DSP and high-performance micro-processors, guaranteeing that your application code will never become redundant.

The SigLib library drastically reduces the development time for a DSP product by allowing the engineer to design their application on a desktop workstation or PC and then deploy on their chosen embedded platform.

Applications of SigLib include: Telecommunications, including wireless, wireline and Voice Over IP; Analysis and active control of sound and vibration, for example drill string; Electronic intelligence; Sonar; Radar; System simulation; Medical imaging; Artificial Intelligence; Machine Learning and Audio effects.

The full source code for the library is open source and free to use in personal and educational applications. The source code can be downloaded from: https://github.com/Numerix-DSP/siglib. SigLib is also available with a commercial license, for which customers receive technical support, upgrade maintenance and DSP algorithm implementation advice.

SigLib Functional Overview

Spectrum Analysis: FFTs forward and inverse – radix-2 and radix-4; real and complex, zoom-FFT and arbitrary length FFTs. Spectrogram, microscan, 2 real with 1 complex FFT, auto and cross power spectrum, power spectral density, chirp z-transform. Welch power spectrum.

Windowing: real and complex - Hanning, Hamming, Blackman, Triangle, Rectangle, Kaiser, Blackman-Harris and flat top; with or without inverse coherent gain compensation.

Filtering: FIR, comb and IIR (including biquad and Nth order, non-causal, all pole and one pole filters), matched filters, filter design methods (Low-pass, High-pass, Band-pass and Notch), polyphase multi-rate (decimation and interpolation), differentiation and integration (including leaky), Hilbert transformers, Goertzel filtering and detection, Gaussian, Lagrange, Farrow and Kalman, raised cosine and root raised cosine filters. Bilinear and matched-z transform. Frequency domain filters (overlap-add and overlap-save).

Adaptive filters: LMS (7 variants).

Machine Learning: Convolutional Neural Network (CNN) Training (fitting) and predicting (inferring), with numerous activation function options.

Array Processing: Add, subtract, multiply, divide, square, square root etc. Decimation and interpolation (both with and without filtering). Coherence detection. Overlap and add. Linear to dB and dB to linear. Mean square error. Automatic Gain Control (AGC) , zero crossing detect.

Control: Proportional Integral and Differential (PID), Pulse Width Modulation (PWM).

Signal Generation: sine, cosine, white and Gaussian noise, chirp (linear and non-linear), square, triangular, sawtooth, impulse, PN sequence, resonators.

Statistical Analysis: mean, average, standard deviation and variance, kurtosis, time and frequency domain interpolation. Combinations and permutations.

Regression Analysis: linear, logarithmic, exponential, power, trend analysis and de-trending.

Imaging Coding And Processing: 3x3 convolution, histogram, 2D FFT, median, Sobel, threshold etc., histogram equalisation, 8x8 DCT forward and inverse, zig zag scan and descan.

Communications: Modulation and demodulation of AM, FSK, CP-FSK, BPSK, Differential BPSK, FM, QAM, DQPSK, QPSK and Differential QPSK. Scrambler / de-scrambler, complex shift, spectral inversion, envelope detection, channel multiplex and de-multiplex. DTMF generation and detection. Bit error rate, interleave / de-interleave. Phase locked loop, Costas loop. Timing error detectors – including zero-crossing and early-late-gate. Trellis coded modulation / convolutional encoders, Viterbi decoders, Euclidean distance. Manchester encoding and decoding. 180 degree phase shift detector. Synchronous to asynchronous converters.

Speech Processing: Pre- and de-emphasis filtering. ADPCM encoding.

Digital Audio Effects: reverb, delay, distortion, echo, pitch shifting (time and frequency domain).

Vector Math: Real and complex; Polar and rectangular functions. Scaling (linear and logarithmic), square root, offset, find : minimum / maximum / middle, clip, threshold, offset, rotate, lengthen and shorten, add, subtract, multiply, divide, histogram, quantise, absolute, peak hold, polynomial expansion, sign, modulus, inverse, conjugate, logarithm, exponential, raise to a power, magnitude, phase and group delay, real and complex dot-product, weighted vector sum.

Utility Functions: Fixed/floating point conversions. Delays and FIFO arrays.

Convolution, Correlation and Covariance: Linear, circular and partial functions. Deconvolution – time and frequency domain.

Matrix Algebra: Add, subtract, multiply, divide, LU decomposition, determinant, linear algebra solving. Column, row and region insert and extract. Column and row swapping.

SigLib supports: 80x86, ARM Cortex; Texas Instruments' TMS320 series; ADI SHARC® and TigerSHARC, XMOS xCORE. ARM®, Keil µVision®, IAR Embedded Workbench®. SigLib is compatible with PortAudio, Qt and wxWidgets OS independent APIs.

SigLib OS support includes: Windows™, Windows Mobile, and Linux. The SigLib DLL and shared objects support: C/C++, Excel, Visual Basic, Keysight VEE™, National Instruments' LabVIEW™. Bindings for Python, Java, Perl, C# and more.

SigLib object code is royalty free, when embedded in executable module(s) which form part, or all, of a product(s).

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