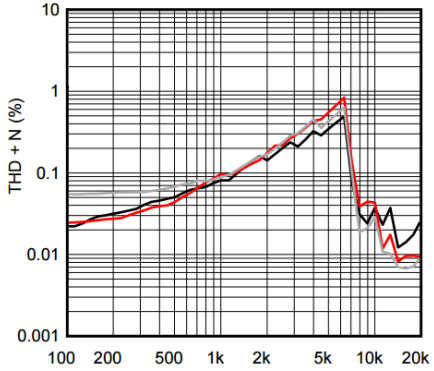
THD+N Estimation

Accurate SNR and THD estimation

A-weighting IEC 61672:2003 and CCIR/ITU-468

Suitable from voice sampling rate to PDM

Code validated with silicon manufacturers



firmware-developments.com

The developer's place

Overview

The purpose of this MATLAB program is to compute the signal to noise ratio (SNR) of audio files.

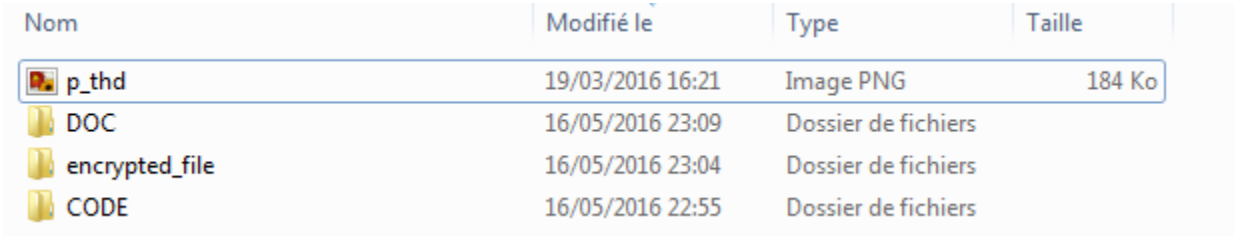
Input files can be of various formats : pulse-density modulation (PDM), raw samples (PCM), in text or binary format.

The program concentrates its analysis in the audio and voice bands.

It can weight the results using ITU/CCIR or using dBA curves.

Optionally, it can cope with jitter and other types of distortions before computing SNR.

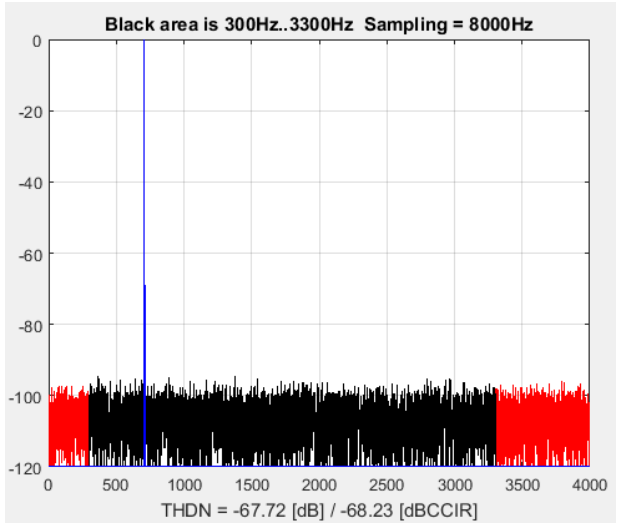
Code folder is http://firmware-developments.com/WEB/P6x/THDN/ :



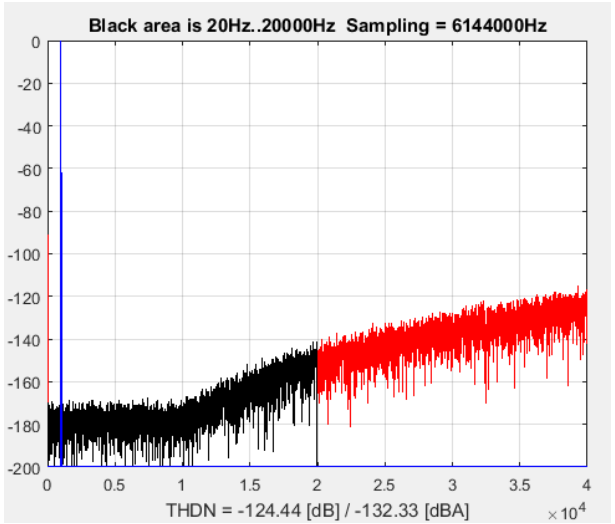
DOC holds this file
CODE is the Matlab code extracts and some data
Encrypted_file stores the Matlab program you can decipher with a key we send you by email.

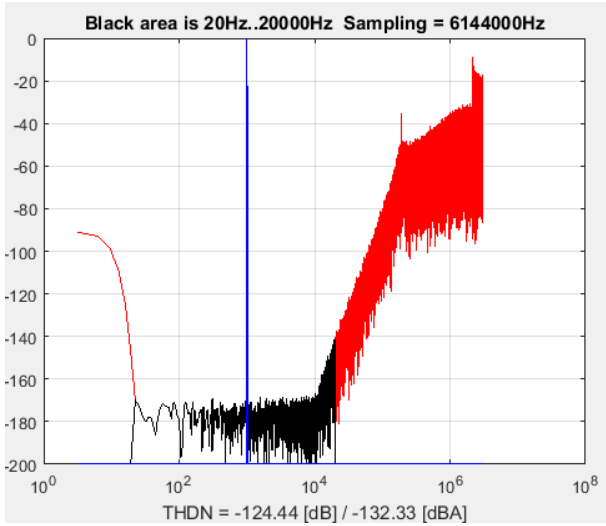
Examples

Example of analysis for a file sampled at 8kHz



Example of analysis at 6.144MHz PDM data rate using linear and logarithm scale.





Function header

```
%=========================================================================================================
function [ thd, thd_weighted, ratio_to_all] = THDN ...
         (input_data, SamplingFreqHz, StartAnalysis, StopAnalysis, Weighting )
%
% THDN computes the total harmonic distortion + noise ratio ratio of a SINEWAVE
%  signal corrupted with noise from different sources (jitter, saturation, pink noise, ..)
%
% INPUT PARAMETERS:
%   input_data      : input vector to be analysed
%   SamplingFreqHz  : sampling frequency in Hz
%   StartAnalysis   : lowest frequency for the noise estimation
%   StopAnalysis    : highest frequency for the noise estimation
%   Weighting       : 0 for A-weighting IEC 61672:2003, 1 for CCIR/ITU-468 weighting
%
% OUTPUT PARAMETERS:
%   thd             : total harmonic distortion and noise ratio in decibel
%   thd_weighted    : THD weighted by the selected perceptual law
%   ratio_to_all    : energy ratio of the useful signal to the total energy
%
%
% MAIN INTERNAL PARAMETERS IN THE CODE:
%
%   window_type     : selection of the analysis window, default is BH7
%   siglev          : rescaling of the useful signal on the plots, default is 0dB
%   glim            : remove the signal lower than this limit, default is -200dB
%   RemoveHarmonics : compute THD after removal of the even and odd harmonics of the signal
%   RemoveJitter    : avoid the noise contribution in the smearing area of a signal corrupted by jitter
%   plot_full_band  : used for PDM modulated signal. Selects the audio band instead of the full signal band
%   plot_log_scale  : plot in semilog or linear
%
%
% EXAMPLE
%
% [fid_r, message_r] = fopen ('pdm_signal_to_analyse.raw', 'r');    % open a PDM audio file at 6.144MHz
% [pdm_data] = fscanf (fid_1,'%d');
% [thd, thd_weighted, r] = THDN (pdm_data, 6144000, 20, 20000, 0);  % thd estimation in [20Hz..20kHz]
% fprintf('THDN_Aw  = %8.3f  = %8.3f bits\n', thd_weighted,  abs(thd_weighted)/6.02);
%
%   THDN_Aw  = -132.327  =   21.981 bits
```

Extract of the “top”

```
%=========================================================================================================
% THDN_TOP.m
%
% Demonstrator of the function THDN
%
%
% THDN computes the total harmonic distortion + noise ratio ratio of a SINEWAVE
%  signal corrupted with noise from different sources (jitter, saturation, pink noise, ..)
%
% Program validated with two versions of Matlab:
%  Matlab Version 7.2 (R2006a), Signal Processing Toolbox Version 6.5 (R2006a)
%  Matlab Version R2015
%
close all; clear all;

select_example = 3;
%
% EXPECTED RESULTS FROM THE THREE EXAMPLES
%
% EXAMPLE1
% THDN     =  -67.718  =   11.249 bits
% THDN_CCIR=  -68.225  =   11.333 bits
%
% EXAMPLE2
% THDN     = -124.436  =   20.670 bits
% THDN_Aw  = -132.327  =   21.981 bits
%
% EXAMPLE3 (Calibration)
% ORIGINAL = -144.500  =   24.003 bits
% THDN     = -144.425  =   23.991 bits
% THDN_Aw  = -147.104  =   24.436 bits



%======= EXAMPLE OF VOICE FILE ANALYSIS =======
if select_example == 1
    % THD of PDM data
    [data_in, Fs, NBITS] = wavread('VOICEBAND.WAV');
    %[data_in, Fs] = audioread('VOICEBAND.WAV');   % instruction to be used starting from Matlab2015
    Selection_A0_CCIR1 = 1;
    [thd, thd_weighted, ratio_to_full_band] = THDN (data_in, Fs, 300, 3300, Selection_A0_CCIR1);
end

%======= EXAMPLE OF PDM FILE ANALYSIS =======
if select_example == 2
    %
    % THD of PDM data recorded at 6.144MHz in a text file
    %  Estimate the THD+N with and without A-weigthed law
    %
    [fid_1] = fopen('PDM6144.TXT','r');
```