Open Source Software for loudness measurement

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Welcome!

Manuel Naudin

- Projects Manager at France Télévisions, the french public television broadcaster.
- Working on loudness since 2011 (E.B.U PLOUD, French Working Group on Delivery Specs, tools specifications, employees training).
What is loudness measurement?

Why should you measure loudness?

Software

- Software usage
- libebur128
- FFmpeg
- freelcs
- Conformance checking

Wrap up
What is loudness measurement?

- A standardized way to measure perceived loudness of audio content.
- Defined by I.T.U and E.B.U in open standards.
- Uses filtering, weighting and integration to produce the results.
- Produces 2 dynamic meters and 3 program descriptors.
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Momentary & Short-Term Loudness

- Dynamic indicators.
- **momentary loudness** is measured on a 400 ms sliding window.
- **short-term loudness** is measured on a 3 s sliding window.
- Mostly used in production.
**Integrated Loudness**

- **integrated loudness** is the average loudness of a complete program.
- It is expressed in LUFS.
- E.B.U R128 target level: -23 LUFS
**Loudness Range**

- **loudness range** is a statistical measure of the loudness levels distribution in a program. (Evaluation of the dynamic of the program).
- It is expressed in LU.
- 20 LU is considered as the maximum loudness range fit for TV broadcasting.
**True-Peaks**

- **true-peaks** are the intersample audio peaks.
- It is expressed in dBTP.
- $\text{true-peaks} \neq \text{sample peaks}$.
- To be taken into account at D/A stage and lossy encoding.
Why should you measure loudness?

- Because of delivery specs or legal constraints.
- To offer a smooth audio experience to your audience.
- To check maximum true-peaks before encoding or broadcasting.
Software usage context

- Realtime or file-based measure.
- Production metering or conformance checking.
- D.A.W plugin or standalone.
- Demux audio data from container.
- Automated workflow.
Software functionalities

- Integrated loudness, loudness range, max true-peaks.
- Logging, plotting, metadata edition/insertion.
- Audio processing (loudness alignment).
libebur128

- Homepage: https://github.com/jiixyj/libebur128
- Licence: Expat (see http://directory.fsf.org/wiki/License:Expat).
- CMake build system.
libebur128, the library

- It’s a C library.
- Easy portability.
- Simple API
- Requires libspeexdsp to measure true-peaks.

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libebur128, the loudness scanner

The scanner needs Glib, GTK and taglib. There is input support for gstreamer, libsndfile, libmpg123, FFmpeg and libmpcdec.

- Measure of various multimedia file formats/codecs.
- Integrated loudness, loudness range and max true-peak descriptors.
- Logging of momentary or short-term loudness.
- ReplayGain tagging.
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**Open Source Software for loudness measurement**

```
manu@mbpro-207647:~/Sources/libebur128/build$ ./loudness dump -m 0.1 /home/manu/test_files/ebu/seq-3341-3-16bit-v02.wav
-42.0
-39.0
-37.2
-36.0
-36.0
-36.0
-36.0
-36.0
-36.0
-36.0
-36.0
-36.0
-36.0
-36.0
-36.0
-36.0
-36.0
-36.0
-36.0
```
FFmpeg

- Homepage: http://www.ffmpeg.org/
- Autotools build system, or thru packages.
The ebur128 filter is part of libavfilter.
Part of the libav* libraries.
Complex API.
Implemented only for 48 kHz sampling rate. Other input sampling rates must be resampled.
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**libebur128**

**freelcs**

**Conformance checking**

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**FFmpeg, the ffmpeg executable**

- Measure of various multimedia file formats/codecs.
- Integrated loudness and loudness range descriptors.
- Logging of momentary and short-term loudness.
- Real-time short-term loudness plotting and momentary loudness bargraph.
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manual@mbpro-207647:~$ ffmpeg -nostats -i /home/manual/test_files/ebu/seq-3341-3-16bit-v02.wav -filter_complex ebur128 -f null -
ffmpeg version git-2013-06-21-5d509fb Copyright (c) 2000-2013 the FFmpeg developers
built on Jun 21 2013 11:12:07 with gcc 4.6 (Ubuntu/Linaro 4.6.3-1ubuntu5)
libavutil 52.37.101 / 52.37.101
libavcodec 55.16.100 / 55.16.100
libavformat 55.9.100 / 55.9.100
libavdevice 55.2.100 / 55.2.100
libavfilter 3.77.101 / 3.77.101
libswscale 2.3.100 / 2.3.100
libswresample 0.17.102 / 0.17.102
libpostproc 52.3.100 / 52.3.100

[wav @ 0x1a86960] max_analyze_duration 5000000 reached at 5013333 microseconds
Guessed Channel Layout for Input Stream #0:0 : stereo
Input #0, wav, from '/home/manual/test_files/ebu/seq-3341-3-16bit-v02.wav':
Duration: 00:01:20.00, bitrate: 1536 kb/s
Stream #0:0: Audio: pcm_s16le ([1][0][0][0] / 0x0001), 48000 Hz, stereo, s16 , 1536 kb/s
Output #0, null, to 'pipe':
Metadata:
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freelcs

- Homepage: http://sourceforge.net/projects/freelcs/
- Licence: GPL.
- Python3 script to install on Ubuntu 12.04.
FreeLCS allows you to build a server that automatically measures and corrects audio loudness according to EBU R128 standard of audio files transferred to it.

freelcs uses libebur128, gnuplot, sox, media info and (optionally) FFmpeg.

Drop your files in the HotFolder, freelcs will measure, create a graphic plot, and correct.

The HotFolder can be shared on the network thru Samba.

Status monitoring by e-mail and web browser.
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**LoudnessCorrection, version 229**

0 Files Waiting In The Queue   2013.07.01 at 11.52.03

Files Being Processed

01:
02:

Completed Files

2013.07.01 at 11.43.08:  1KHz Sine -20 LUFS-16bit.wav
2013.07.01 at 11.43.08:  seq-3341-6-4channels-WAVEEX-16bit.wav
2013.07.01 at 11.43.03:  seq-3341-6-5channels-16bit.wav
Conformance Checking

- 2 sets of audio files for integrated loudness and loudness range conformance checking: *E.B.U loudness test set v3* and *Compliance material for Recommendation ITU-R BS.1770*.
- *libebur128* and *FFmpeg* pass successfully!
- Unfortunately, there’s no true-peak conformance test endorsed by I.T.U.
### Table

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<thead>
<tr>
<th>software</th>
<th>IL</th>
<th>LRA</th>
<th>MAX TP</th>
<th>MOM</th>
<th>SHORT</th>
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Performance on a 4’30" .mp4 file with AAC-LC 64 Kbps 48 kHz stereo audio stream.
libebur128 (with true-peak and loudness range) : $\approx 10$ s.
libebur128 (with loudness range) : $\approx 4.4$.
ffmpeg (with momentary and short-term dump) : $\approx 5$".

-- Manuel Naudin

Open Source Software for loudness measurement
There are several open source solutions available for loudness measurement.
They are mostly fit for file-based measurement.
To use them in an automated workflow requires some development.
Plugins?
Questions?
Contact: manuel.naudin@francetv.fr