The Audio Degradation Toolbox

http://code.soundsoftware.ac.uk/projects/audio-degradation-toolbox/

and its Application to Robustness Evaluation Sebastian Ewert and Matthias Mauch

reverb

photo by steveleenow

Friday, 1 November 13



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photo by dan taylor

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bad analog-to-digital conversion

photo by emilio di fabio

low quality microphone

photo by JeffaCubed

Environmental noise

...and many other things degrade audio.

- irregular tape playback
- dynamic range compression in radio and tv broadcasts
- audio speedup on the radio
- noise
- clipping and other distortion
- ... and yet more.

Audio Collection Quality

- most audio collections
 - contain some audio of low quality
 - contain recordings of different qualities
 - contain recording of unknown quality



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Impact on Music Informatics

- methods are usually tested only on one (or few) audio collections, hence:
 - feature extractors (etc.) might fail in the real world affects MIR researchers' work
 - if feature extractors work, it is not clear if they corrleate with content or audio quality affects 'digital musicologists' and industry

Audio Degradation Toolbox

- most comprehensive collection of Matlab code for audio degradation
- designed to make it easy to degrade audio in many different ways
- aim: encourage MIR
 researchers to test their
 algorithms under many
 different conditions

🛷 Home 🤱 My page 💰 Projects 💿 Help Logg Search: Audio Degradation Toolbox Audio Degradation T Overview Members Activity Publications Downloads Repository Code docs Settings New subproject () Add publication to this project Overview The Audio Degradation Toolbox (ADT) consists A Members of Matlab code for the controlled degradation of audio signals, and for the adaptation of Manager: Matthias Mauch, Sebastian Ewert ground-truth to the degraded audio. Main purpose is to test the robustness of audio analysis methods against certain classes of Recent activity degradations of the audio quality. Degradation units include: add noise, add 2013-08-08 01:99 pm Matthias Mauch sound, aliasing, clipping, dynamic range audio-degradation-toolbox-0.1.tar.gz compression, harmonic distortion, highpass Version 0.1 of the Audio Degradation Toolbox filter, apply impulse response, mp3 compression, speedup, wow resampling. These 2013-08-08 01:36 pm Matthias Mauch 壍 units can be combined into more complex. Revision 2:eaabf5f6748f: Added tag version 0.1 for degradations. For more info see our O ISMIR changeset 48a6ea9de6ac paper. 2013-08-08 01-28 pm Matthias Mauch 躉 **Getting Started** MauchEwert_ADT_ISMIR2013.pdf ISMIR paper on the Audio Degradation Toolbox Get the most current version of the toolbox from our @ Mercurial repository. Alternatively, 2013-08-08 11:01 am Matthias Mauch download it from our O Downloads page Revision 1:48a6ea9de6ac: added .hgignore keeping in mind that this may not include recent bug fixes or extensions. 2013-08-08 12-01 am Matthias Mauch Revision 0.9d682f5e3927: put files here from the Requirements: the toolbox requires Matlab and the Matlab Signal Processing Toolbox. We've old repository tested the ADT with Matlab R2011b on Mac OSX, Matlab R2013a on Linux. Actually getting started: try the demo scripts in the root directory of the distribution. License The Audio Degradation Toolbox (ADT) is

GPL open source on SoundSoftware

released under the GNU General Public

Degradation Units



Degradation Units



Degradation Units



Degradation Unit Example

- example sound before / after
- why "timestamps" we'll see later.

Degradations

- to make complex "Degradations" we can make chains from degradation units
 - Iike audio effects!
- Example: Radio Broadcast Degradation

Dynamic Range Compr. Speedup

Degradations

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 - … like audio effects!
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Degradations — examples

 Lots of audio examples (file://localhost/Users/ matthiasm/code/audio-degradation-toolbox/ html/audio_examples.html)

Examples with spectrogram:

Wow resampling on cello (file6)

Live Recording on file1

Comparing to Ground Truth

- one main purpose: evaluate methods under different degradations
- problem we have time-distorting degradations
- solution: every degradation can also transform ground truth to the time line of the degraded audio
 - example: beat tracking ground truth after "Speedup" degradation

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original ground truth

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Revisit Example



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Experiments on 'Real-World' Degradations

Live Recording

Radio Broadcast

Smartphone Playback

Smartphone Recording

Strong MP3 Compression

Vinyl Recording

Results I — Audio ID

- audio ID fails for most "Real-World" degradations, not for mp3
- robustness to pink noise is ok

	correct	incorrect	not identified
Original	100	0	0
Live	0	0	100
Radio	3	3	94
PhonePlay	0	1	99
PhoneRec	5	7	88
MP3	100	0	0
Vinyl	4	0	96

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TUU

Results I — Audio ID

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TUU

Results II — Score-to-audio alignment

 pretty much falls over for "Live" and "Phone
 Playback" degradations

 explanations: onset duplication; bass harmony missing





Results III — Beat-tracking

- compare two methods: BeatRoot, Davies
- very similar, but Davies more robust to "Live"



Results IV — Chord

recognition

- compare two methods: Chordino, HPA
- HPA usually better, Chordino more robust on "Phone Play"

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Summary

- Audio Degradation Toolbox offers
 - easy-to-use degradations
 - more comprehensive than other existing toolboxes
 - ground truth time-line transform to evaluate on timewarping degradations
- Results show: ADT is useful to detect strengths and weaknesses of MIR methods
- For paper, audio examples, source code: <u>http://code.soundsoftware.ac.uk/projects/audio-degradation-toolbox</u>

What's up next?

- convince everyone to use the ADT :)
- work with it ourselves...
 - degraded audio as additional training data
 - affect of degradation on human ground truth labelling