# The Audio Degradation Toolbox and its Application to Robustness Evaluation



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#### Abstract

We introduce the Audio Degradation Toolbox (ADT) for the controlled degradation of audio signals, and propose its usage as a means of evaluating and comparing the robustness of audio processing algorithms.

Music recordings encountered in practical applications are subject to varied, sometimes unpredictable degradation. For example, audio is degraded by lowquality microphones, noisy recording environments, MP3 compression, dynamic compression in broadcasting or vinyl decay.

In spite of this, no standard software for the degradation of audio exists, and music processing methods are usually evaluated against clean data.

The ADT fills this gap by providing Matlab scripts that emulate a wide range of degradation types. We describe 14 degradation units, and how they can be chained to create more complex, `real-world' degradations. The ADT also provides functionality to adjust existing ground-truth, correcting for temporal distortions introduced by degradation.

## Example: the 'Radio Broadcast' degradation



Any degradation can have two inputs:

Both inputs are are transformed by the individual degradation units that make



Compression, which imposes a delay on

Using four different music informatics tasks, we show that performance strongly depends on the combination of method and degradation applied. We demonstrate that specific degradations can reduce or even reverse the performance difference between two competing methods.

ADT source code, sounds, impulse responses and definitions are freely available for download.

### Why an Audio Degradation Toolbox?

- evaluation is essential to improving audio processing methods
- testing on clean data sets is good, but signal processing methods should be tested on realistic data because
  - real-world data sets are of unpredictable quality
  - real-world data sets are often bad quality
- no tool for systematically producing degraded audio existed

#### **ADT Features / Implementation**

- in Matlab, source code here: http://code.soundsoftware.ac.uk/projects/ audio-degradation-toolbox
- degrades audio and optionally transforms ground truth timestamps to match the degraded audio
- two levels
  - 14 degradation units (see box) below)

### **Results — Applying the ADT**

- evaluation of 4 different MIR tasks
  - audio fingerprinting lacksquare(EchoNest)
  - score-to-audio alignment (Ewert's method)
  - beat-tracking (Davies vs. BeatRoot)
  - chord detection (HPA vs. Chordino)

- using degraded audio meant reinventing the wheel, hence inconsistent across papers
- degrading audio required a lot of extra work, unattractive to researchers with little time

#### Aims of the ADT

- provide easy-to-use tool to degrade audio in many different ways
- support evaluation by providing means to transform ground truth timestamps along with the audio
- facilitate comparison of evaluation results by providing well-defined degradations
- contribute to more robust signal

- limitless degradations (chains of units, see example above)
- comes with pre-defined complex degradations
- comes with example batch processing scripts

### Data included in the ADT

- sounds included: pub sound environment, vinyl crackle
- impulse responses: large halls, microphone and speaker of a smartphone, vinyl player

# **Degradation Units**



- applied 6 degradations simulating 'real-world' scenarios (see box)
- each task susceptible to specific degradations
- methods for the same task significantly differ in their robustness

	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
-			

Audio Fingerprinting

EchoNest's Audio ID is extremely accurate on the original recording and strong MP3 compression, but essentially fails for all other degradations.



#### processing methods

Open source code and examples available on SoundSoftware

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

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The Audio Degradation Toolbox (ADT) consists of Matlab code	Polated publications
for the controlled degradation of audio signals, and for the	
for the controlled degradation of audio signals, and for the adaptation of ground-truth to the degraded audio. Main purpose is to test the robustness of audio analysis methods against certain classes of degradations of the audio quality.	<ul> <li>M. Mauch and S. Ewert, "The Audio Degradation Toolbox and its Application to Robustness Evaluation", in <i>Proceedings of the 14th</i> Interactional Society for Music Information Patriceal Conference</li> </ul>

# **Degradations Used in Paper**

