

ADAMS

Advanced **D**ata mining **A**nd **M**achine learning **S**ystem

Module: adams-audio



Peter Reutemann

January 7, 2021

©2018-2020



THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato



Except where otherwise noted, this work is licensed under
<http://creativecommons.org/licenses/by-sa/4.0/>

Contents

1	Introduction	5
2	Flow	7
2.1	Spectrograms	8
3	Conversion	11
3.1	Audio filters	11
	Bibliography	13

Chapter 1

Introduction

The *adams-audio* module offers some basic audio processing functionality, like extracting information from audio files and reading their data.

There are some very good, open-source tools for processing audio:

- *ffmpeg*[4] – command-line tool, swiss army knife for audio and video processing (extraction and conversion).
- *Audacity*[5] – user interface for recording and editing multi-track audio files.

Chapter 2

Flow

The following sources are available:

- *AudioRecorder* – records audio using the specified recorder.
- *NewAudioAnnotations* – creates an empty audio trail data structure.

The following transformers are available:

- *AddAudioAnnotation* – adds an audio annotation.
- *AudioData* – reads the data from an audio source, eg a file
- *AudioInfo* – generates information about an audio source
- *AudioAnnotationsFileReader* – reads audio annotations from disk.
- *AudioAnnotationsFileWriter* – writes audio annotations to disk.
- *AudioAnnotationsFilter* – applies a filter to an audio annotations.
- *WaveFeatureGenerator* – generates features from a Wave object using the specified generator
- *WaveFilter* – applies the specified filter to the Wave object.

The following sinks are available:

- *AudioPlayback* – can playback audio files (e.g., MP3 or Wave).
- *MP3ToWave* – converts MP3 files to Wave ones.

The following Wave filters are available:

- *Cut* – Cuts out a portion of the Wave object
- *PassThrough* – dummy, does nothing
- *Resample* – resample the amplitudes to a new sample rate
- *Trim* – removes data left and right

The following conversions are available:

- *SpectrogramToBufferedImage* – turns a spectrogram into an image
- *WaveToAmplitudes* – extracts the amplitudes from a Wave object
- *WaveToSpectrogram* – generates a spectrogram from a Wave object

The following Wave feature generators are available:

- *Fingerprint*
- *Histogram*
- *Spectrogram*

2.1 Spectrograms

There are currently two ways of generating spectrogram output:

- image
- tabular data

In order to generate an *image* of a spectrogram, you need to:

- turn the *Wave* container into a spectrogram data structure, using the *WaveToSpectrogram* conversion
- turn the *Spectrogram* data structure into an image using the *Spectrogram-ToBufferedImage* conversion

Example flow *adams-audio-wav_spectrogram_image.flow* incorporates these steps and Figure 2.1 shows the generated example image.

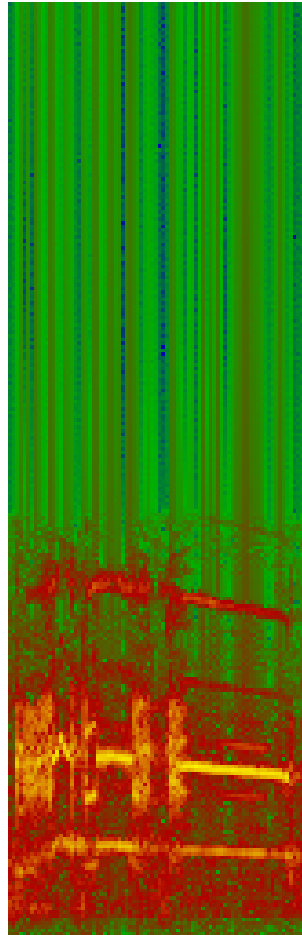


Figure 2.1: Spectrogram with gradient using multiple colors.

If you want to generated *tabular data* from a spectrogram, you need to:

- generate features from the *Wave* container using the *WaveFeatureGenerator* transformer with the *Spectrogram* feature generator
- what kind of output is being generated, is determined by the *converter* that is part of the feature generator

Example flow *adams-audio-wav_spectrogram.flow* shows how to do this.

Chapter 3

Conversion

Since the *adams-audio* module is limited to using WAV (aka PCM) files, you need to convert other audio formats first. You can do this, either on the command-line outside ADAMS (e.g., using *ffmpeg* or *avconv* natively), or using the *FFmpeg* sink actor. The latter provides a wrapper around *ffmpeg/avconv*.

Here is an example command-line conversion of an MP3 file into a WAV one, using *ffmpeg*:

```
ffmpeg -i sample.mp3 -acodec pcm_s16le -ar 44100 sample.wav
```

Use the following command-line to list all the available *encoders* that are available on your system:

```
ffmpeg -encoders
```

3.1 Audio filters

ffmpeg can be used to apply audio filters as well. See the following website for more details:

<http://www.ffmpeg.org/ffmpeg-filters.html#Audio-Filters>

Bibliography

- [1] *ADAMS* – Advanced Data mining and Machine learning System
<https://adams.cms.waikato.ac.nz/>
- [2] *WAV* – Waveform Audio File Format
<https://en.wikipedia.org/wiki/WAV>
- [3] *MP3* – MPEG-1 Audio Layer III
<https://en.wikipedia.org/wiki/MP3>
- [4] *ffmpeg* – A complete, cross-platform solution to record, convert and stream audio and video.
<https://ffmpeg.org/>
- [5] *Audacity* – A free, open source, cross-platform audio software for multi-track recording and editing.
<http://www.audacityteam.org/>