

Calcium Signal Analyser Vamp plugin documentation

Mathieu Barthet
School of Electronic Engineering and Computer Science,
Centre for Digital Music,
Queen Mary University of London
`mathieu.barthet@eeecs.qmul.ac.uk`

1 Copyright

The Calcium Signal Analyser is a Vamp plugin for the detection and characterization of transients in noisy signals. It is adapted for the analysis of calcium signals measured using confocal microscopy.

The Vamp architecture is a feature extraction system developed at Queen Mary University of London (see more information at: <http://www.vamp-plugins.org/>).

This code is Copyright (c) 2010-2011 Mathieu Barthet, Queen Mary University of London. The plugin is based on the QM Vamp note onset detector developed by Christian Landone, Chris Duxbury, and Juan Pablo Bello.

2 About this release

This is release 1.

3 License

This program is free software; you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation; either version 2 of the License, or (at your option) any later version. See the file COPYING included with this distribution for more information.

4 Pre-requisites

Several host applications (i.e. applications from which the plugin can be launched) exist for Vamp plugins such as Sonic Visualiser [1] [2], or Audacity [3]. One of

them should be installed before installing the plugin. The batch tool Sonic Annotator [4] can also run Vamp plugin¹.

In the following, Sonic Visualiser will be used as a host application to describe the plugin's functioning.

5 Installation

To install the plugin on a Win32 system (Windows XP, Vista), copy the files:

vamp-calcium-signal-analyser.dll
vamp-calcium-signal-analyser.cat (optional)
vamp-calcium-signal-analyser.n3 (optional)

into the folder "C:\Program Files\Vamp Plugins\" (if the directory does not already exist, then create it).

To install the plugin on a Apple OS/X operating system, compatible with both PPC and Intel hardware, copy the files:

vamp-calcium-signal-analyser.dylib
vamp-calcium-signal-analyser.cat (optional)
vamp-calcium-signal-analyser.n3 (optional)

to either:

/Library/Audio/Plug-Ins/Vamp/ (for the plugin to be available to all users), or
\$HOME/Library/Audio/Plug-Ins/Vamp/ (for the plugin to be available to you only).

6 Parameters

The Calcium Signal Analyser plugin has two input parameters:

- the peak-picking Sensitivity S which can vary in the range 0-100 % by steps of 1%;
- the peak-picking offset threshold (δ) which can vary in the range 0-1 by steps of 0.05.

¹However, the current version of Sonic Annotator is not adapted to process files sampled at very low sample rate such as 3 Hz. Indeed, the data is processed with blocks of 16384 samples by default (whereas a typical calcium signal only contain 1000 samples).

7 Outputs

The Calcium Signal Analyser plugin has five output parameters:

- the Smoothed Detection Function (*SDF*), i.e. the detection function after signal conditioning and adaptive thresholding / Type: two-dimensional vector (the first dimension corresponds to the time labels and the second dimension to the data values);
- the Peak Times (*PT*), i.e. the time positions in seconds of the peaks / Type: one-dimensional vector;
- the Peak Onsets (*PO*), i.e. the start times in seconds of the peaks / Type: one-dimensional vector;
- the Peak Frequency (*PF*), i.e. the frequency of the peaks in Hz / Type: one-dimensional value;
- the Mean Inter Peak Interval (*MIP*), i.e. the mean time interval in seconds between peaks / Type: one-dimensional value.

8 Use of the plugin with Sonic Visualiser

8.1 Load a file

In order to load an audio file in Sonic Visualiser, go to the File menu, and then click on Import Audio File. Then, select the WAV file to analyse.

8.2 Feature extraction using a transform

In order to process the loaded file, go to the Transform menu, then choose e.g., Analysis by Plugin Name, select the Calcium Signal Analyser plugin, select one of the five outputs (Smoothed Detection Function, Peak Times, Peak Onsets, Peak Frequency, Mean Inter Peak Interval). In order to obtain several outputs, the same process has to be repeated.

8.3 Optional manual corrections

The editing tools of Sonic Visualiser allows us to modify the outputs (layers) manually: e.g., remove or add a new Peak Time. In order to see the values associated to a given layer, go to the Layer menu, and then Edit Layer Data. Peaks which are manually added appear with the label 'New Point' in the Peak Times Layer Data. Note that the manual modifications performed on the Peak Times do not induce a recalculation of the Peak Frequency and Mean Inter Peak Interval parameters. If manual corrections are performed, these parameters would need to be recomputed in a post-processing stage.

8.4 Exportation of the results

Once the peak detection is performed, the results can be exported (e.g., in a CSV text file) for further analyses. For this purpose, go to the File menu, and then Export Annotation Layer.

9 Sonification

Sonic Visualiser can provide an auditory feedback of the peaks localized by the plugin. Other types of sonification can be made by post-processing the data. Some sound examples are provided at the address given in reference [5].

10 Credits and references

The Calcium Signal Analyser Vamp plugin has been developed within a Queen Mary University of London Bridging the Gap project between the School of Biological and Chemical Sciences (Dr Rachel Ashworth) and the School of Electronic Engineering and Computer Science (Dr Katy Noland, Dr William Marsh, Dr Mathieu Barthet). It is based on previous works made at QMUL's Centre for Digital Music by Christian Landone, Chris Duxbury and Juan Pablo Bello.

References

- [1] C. Cannam, C. Landone, and M. Sandler. Sonic Visualiser: An open source application for viewing, analysing, and annotating music audio files. In *Proceedings of the ACM Multimedia 2010 International Conference*, pages 1467–1468, Firenze, Italy, October 2010.
- [2] Queen Mary University of London. Sonic Visualiser. <http://www.sonicvisualiser.org/>.
- [3] Audacity. <http://audacity.sourceforge.net/>.
- [4] Queen Mary University of London. Sonic Annotator. <http://omras2.org/SonicAnnotator>.
- [5] M. Barthet and K. Noland. Calcium Signal Analyser: Sound examples. <http://isophonics.net/content/calcium-signal-analyser>.