

Operation manual of Soundscape_viewer.exe

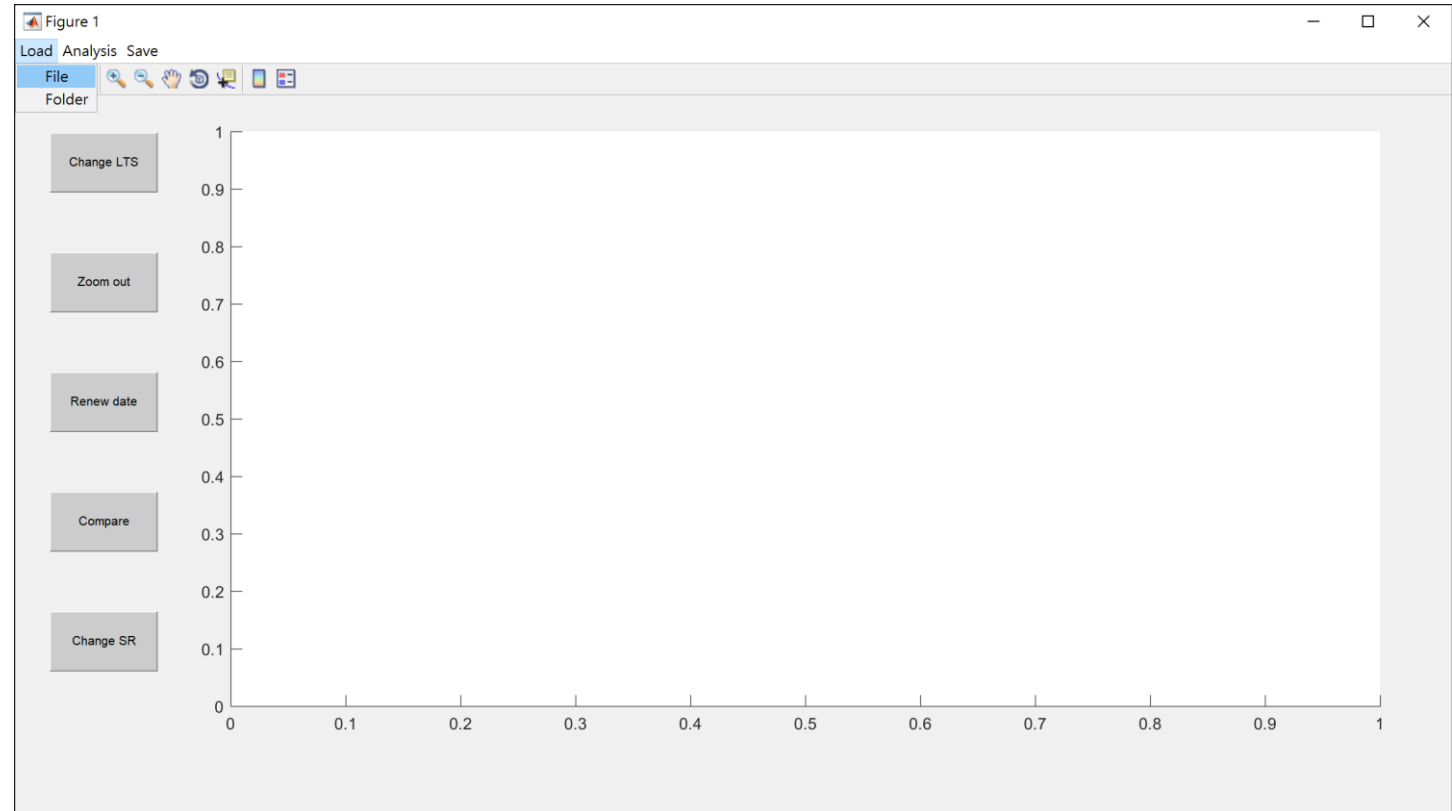
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Preparation of using Soundscape_viewer.exe

- Install MATLAB Runtime R2017a (9.2)
<https://www.mathworks.com/products/compiler/matlab-runtime.html>
- Prepare a long-term spectrogram (LTS) or multiple long-term spectrograms in a folder
 - Mat files generated by LTSA_gui.exe
 - (Optional for loading a folder)
Remove those mat files you don't want to analyze in the same folder
 - (Optional) Prepare all the acoustic recordings associated to the long-term spectrograms.

Control panel of Soundscape_viewer.exe

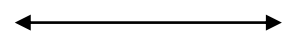
- **Load panel**
 - File
 - Folder
- **Analysis panel**
 - Unsupervised separation
 - Supervised separation
 - Clustering
- **Save panel**
 - Long-term spectrogram
 - Soundscape separation model



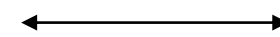
Visualize the long-duration recordings

- You can load a mat file, or the entire folder contains multiple files from the same recording location
- After data loading, you can switch the visualization from median-based, mean-based, and difference-based long-term spectrograms by pressing the button of **Change LTS** control button
- You can also see the detail of a LTS by using the zoom in/out and pan functions on the figure toolbar, renew the date and time after zoom in/out by using the **Renew date** control button
- There is also a **Zoom out** control button on the left side for you to directly zoom back to the original view of LTS

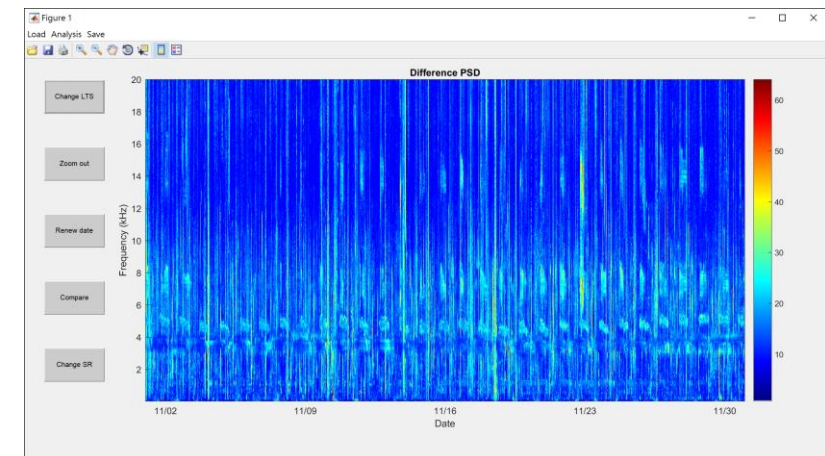
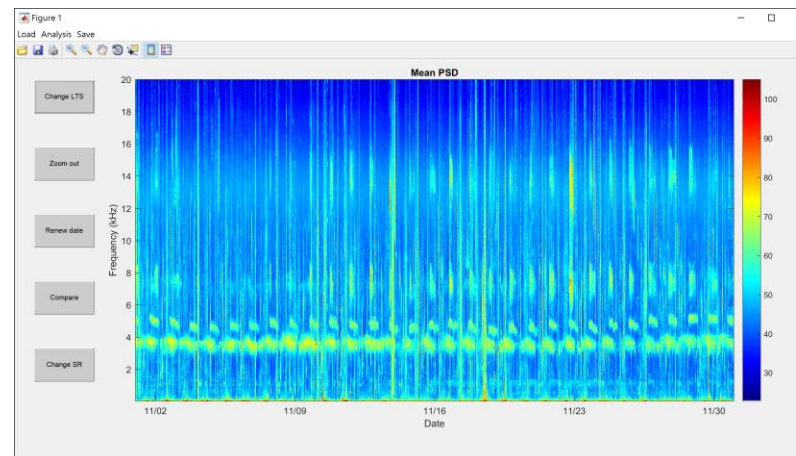
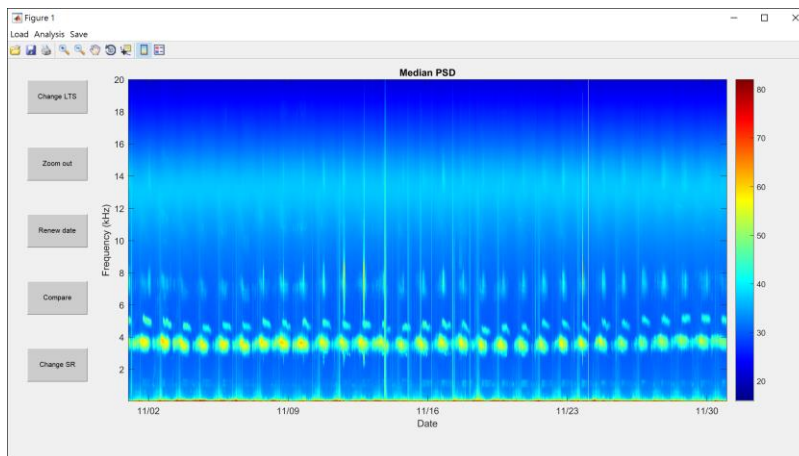
Spectral median



Spectral average

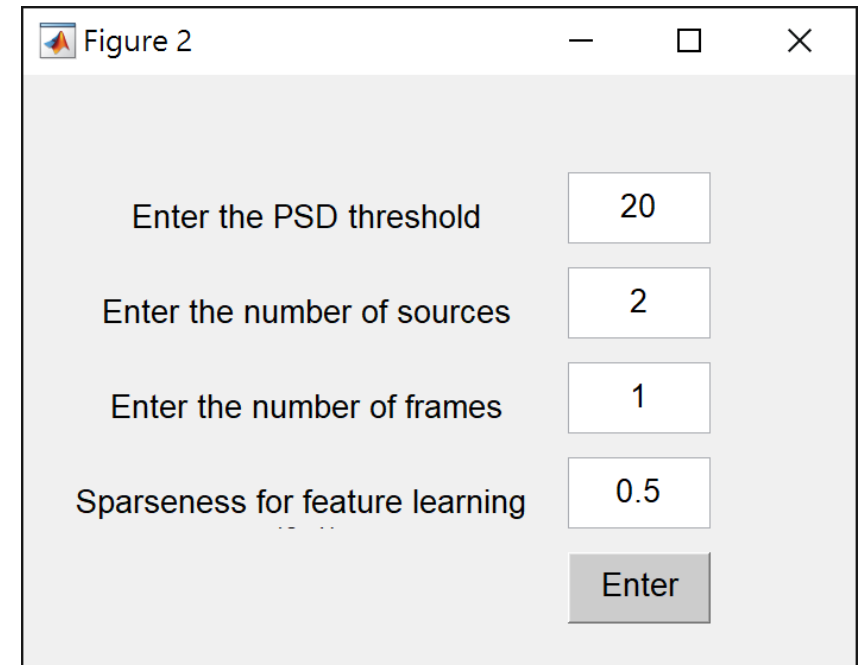


Mean - median



Unsupervised separation of a LTS

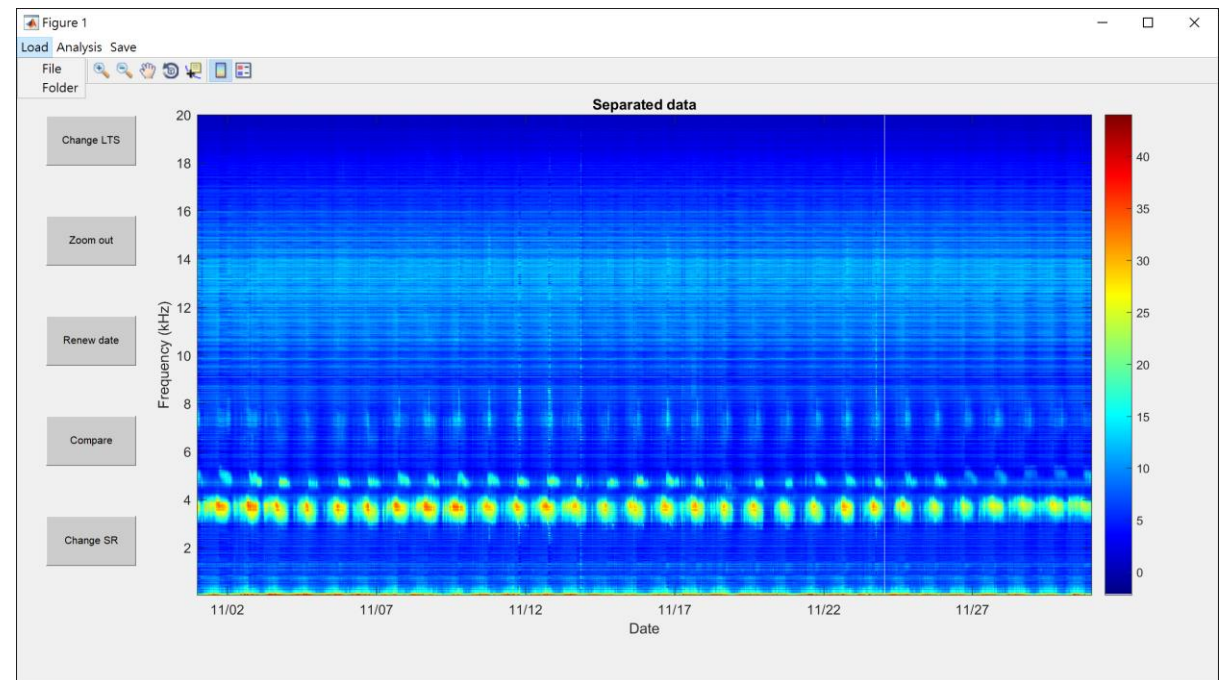
- Go to the **Analysis panel** and press the button of **Unsupervised separation**
- A window will display and ask you to correct the parameters for soundscape separation
 - PSD threshold: the lowest PSD value you want to analyze
 - Number of sources: how many sources you want to separate
 - Number of frames: frame length of spectral features
 - Feature sparseness: sparsity constraint for feature learning (0-1)
- Press the **Enter** button to run the unsupervised separation, the PC-NMF will try to distinguish different sound sources based on the periodical occurrence pattern learned from the selected LTS



Enter the PSD threshold	20
Enter the number of sources	2
Enter the number of frames	1
Sparseness for feature learning	0.5
<input type="button" value="Enter"/>	

Check the separation result

- Once the learning procedure has been done, the first separated source will be displayed. You can compare the separation result from the original LTS by using the **Compare** control button
- You can also switch to another separated source by pressing the button of **Change SR**
- If you satisfy with the separation result, then you can save the separated LTS or the separation model by using the functions in **Save** panel



Supervised separation of a LTS

- If you already have a separation model, then you can use it to separate the sound sources in an supervised manner
- Press the **Supervised separation** button in the **Analysis** panel, a window will appear and ask you to select the mat file of separation model
- Then program will use the existing spectral dictionary to learn a new temporal encoding matrix, and use the basis clustering information to separate different sound sources

Clustering of soundscape events

- Soundscape Viewer also provide a function to use *k*-means clustering to investigate the structure of soundscape. You can press the **Clustering** button in the **Analysis** panel, a window will be displayed to ask you enter two parameters for clustering
 - Feature threshold: the minimum PSD or SNR you want to analyze
 - Variation of clustering (%): percentage of data variation explained by the clustering result
- It is not necessary to define the number of cluster, instead, the algorithm will search the optimal number of clusters which can explain the defined percentage of data variation
- Press the **Enter** button to proceed

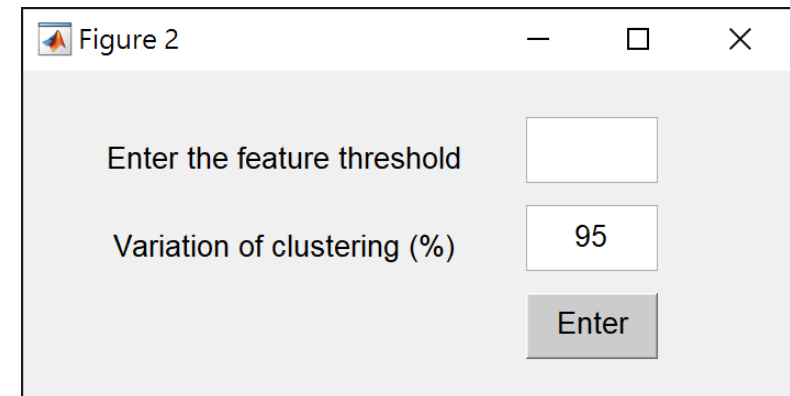


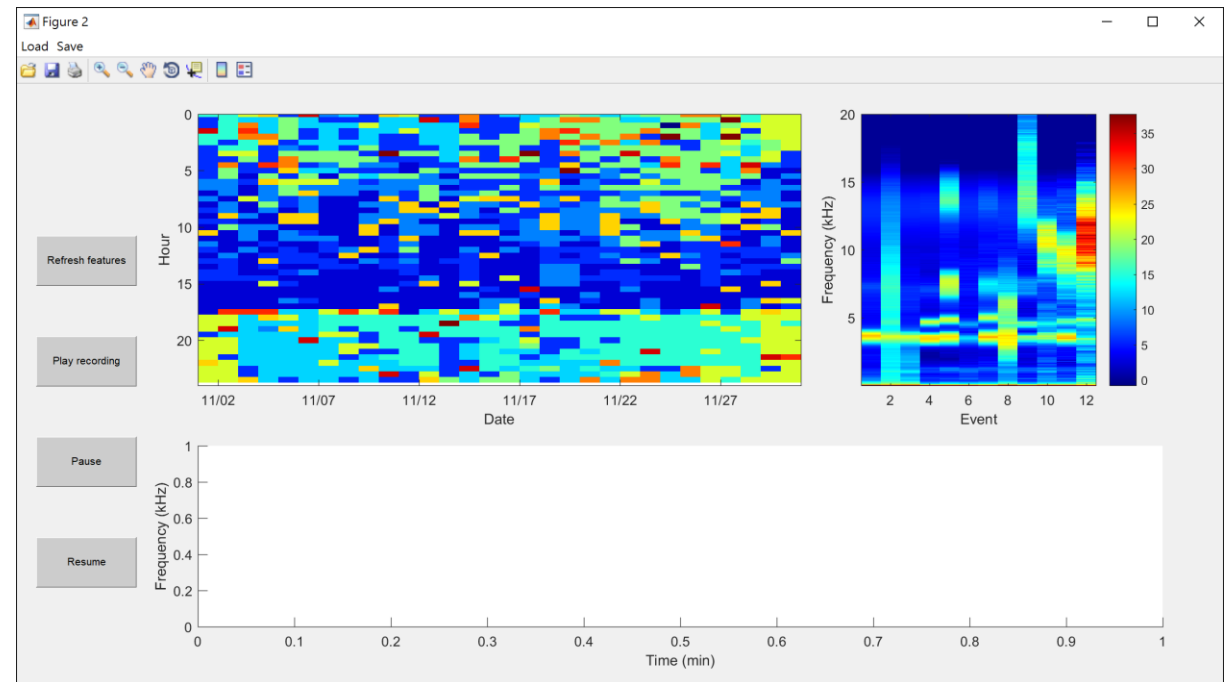
Figure 2

Enter the feature threshold

Variation of clustering (%)

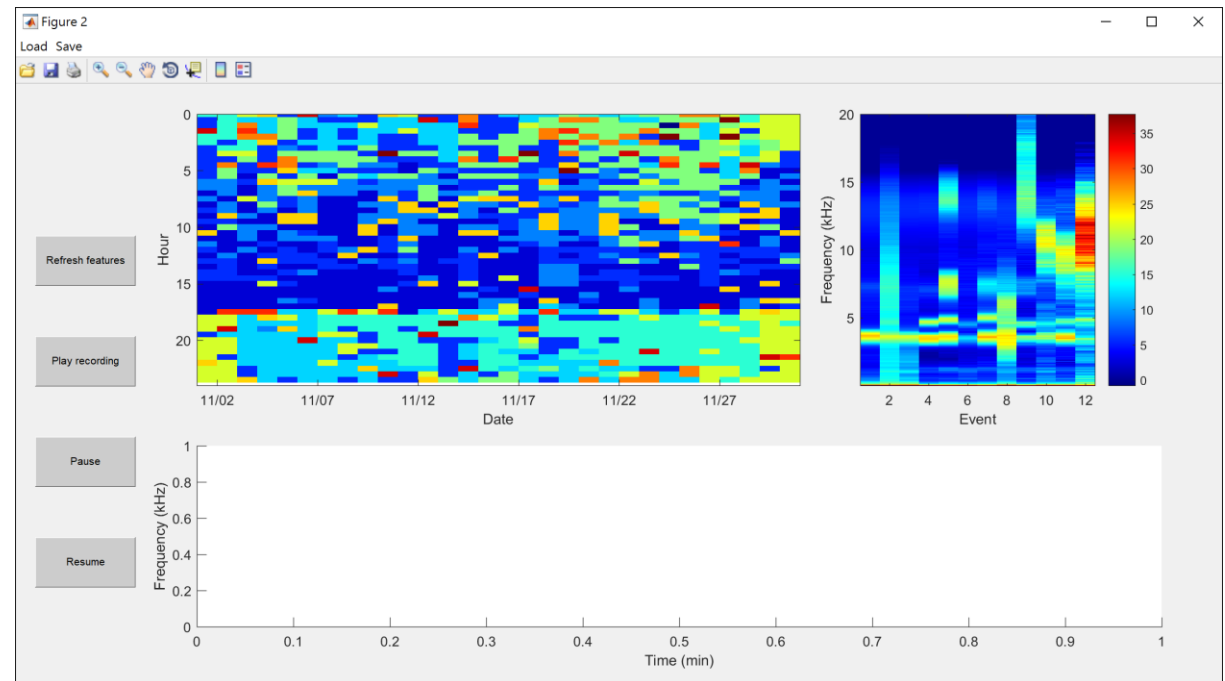
Establish the linkage between clustering result and recording files

- After the clustering analysis, a window will appear and ask you to select the folder contains all the recordings associated to the LTS
- Please rename the folder name by the initials before the time label.
 - For example, if your recording file looks like this: **TW_TFRI_LHC01_20141101_120000.wav**.
Then rename the folder as **TW_TFRI_LHC01_**
- The program will try to link the clustering result to all recording files in the folder you select



Visualization of clustering result

- The upper left panel shows the change of clusters in 24 hours and different recording days. The upper right panel shows the spectral feature for each cluster. You can save the clustering result by pressing the **Save** panel, a csv file will be saved. Please rename the csv file or otherwise it may be replaced by another clustering result if you press the **Save** panel again.
- You can also visualize a previous-saved clustering result by using the **Load** panel



Explore the soundscape

- You can explore the clustering result by pressing the **Play** recording control button, move your mouse to the upper left panel. Please move the cursor to the day and htime you want to listen, and left-click your mouse.
- The audio will be played and a spectrogram will be displayed if the link between the clustering result and audio files has been correctly established. You can stop or resume the recording by using the **Pause** or **Resume** control buttons. You can also use the **Refresh features** control button to show the spectral features or the entire clusters again.

References

- Lin et al. (2017) Improving biodiversity assessment via unsupervised separation of biological sounds from long-duration recordings. Scientific Reports, 7:4547. <https://www.nature.com/articles/s41598-017-04790-7>
- Lin et al. (2017) Computing biodiversity change via a soundscape monitoring network. PNC 2017 Annual Conference and Joint Meetings. DOI: 10.23919/PNC.2017.8203533. <https://1drv.ms/b/s!AigsXgLDF7RIwrhSyHi2bT6WxYEMfQ>