VoiceSplit: Targeted Voice Separation by Speaker-Conditioned Spectrogram

Course: SCC5830 - Image Processing - 2020
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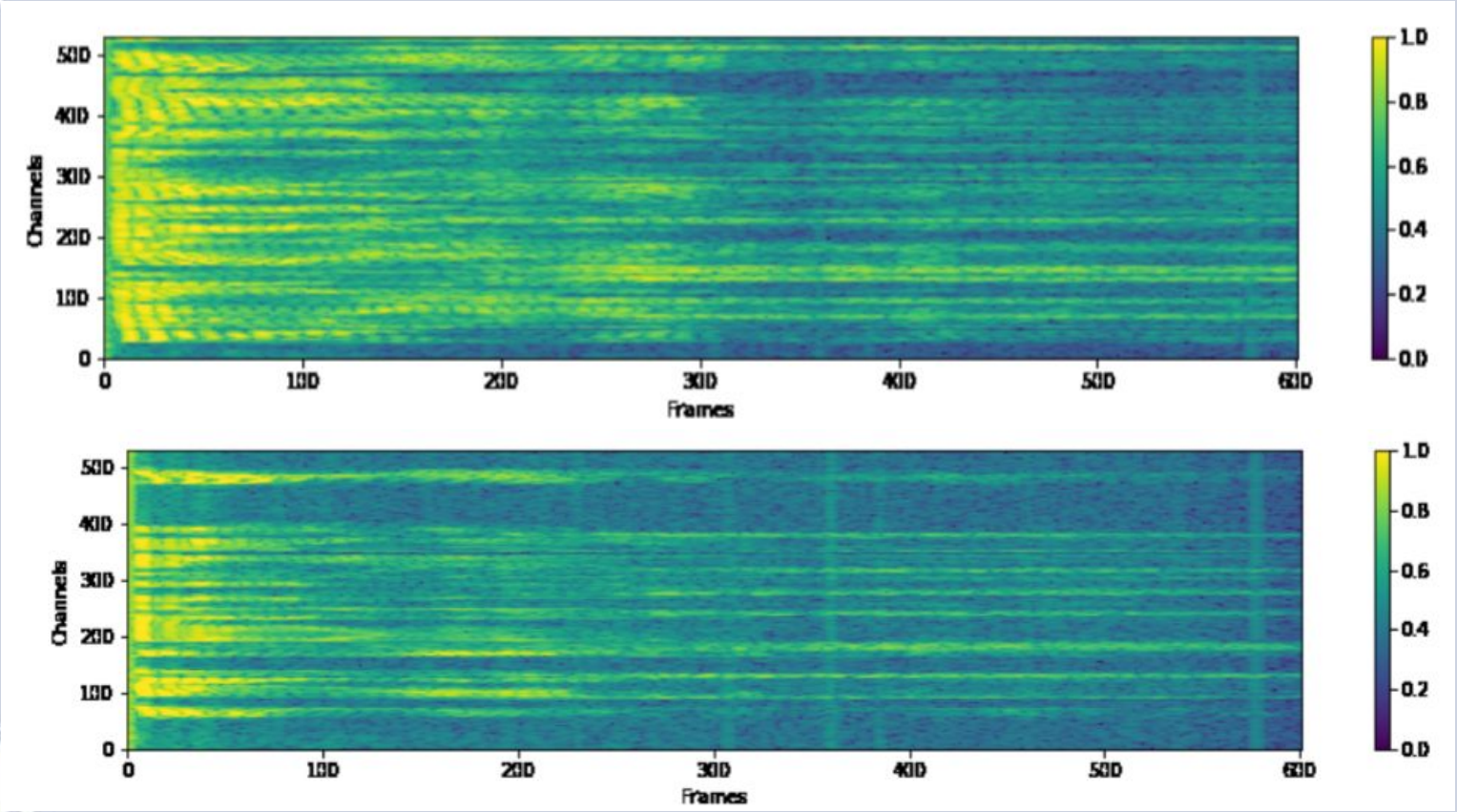
Project Github: https://github.com/Edresson/VoiceSplit

Introduction

- This Project goal is the development of a system that, given an audio input, is able to separate overlapping voices through the use of Spectrograms, based on the characteristics of each speaker's speech patterns.

Introduction



Introduction

- For the development of this work we used the Google VoiceFilter system.
- This work's contributions are as follows:
  - Proposes improvements for the architecture of the VoiceFilter model;
  - It is the first work that compares the performance of different loss functions in this scenario;
  - All of our experiments are open source and can be used freely by the community.

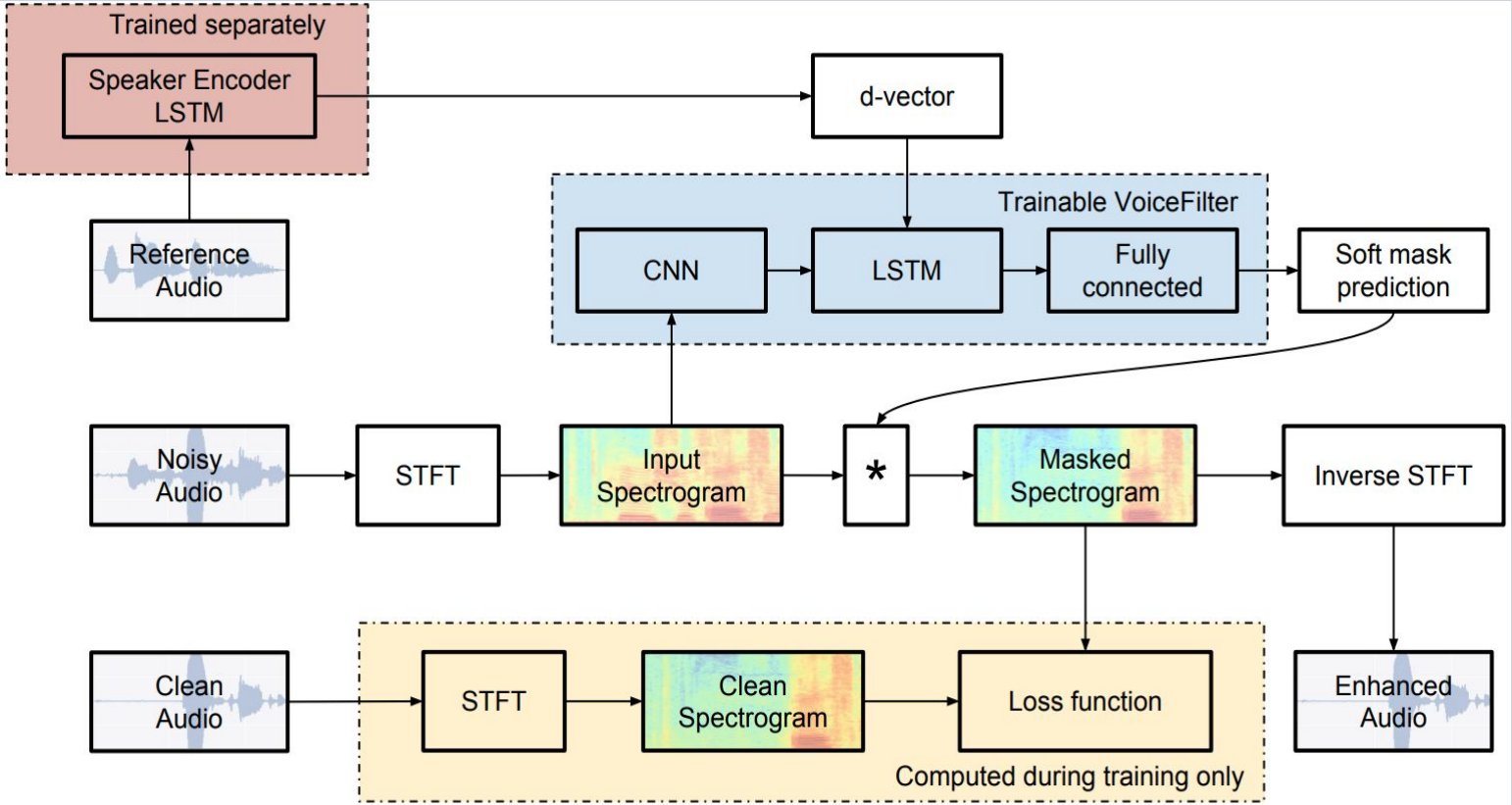
VoiceFilter

- VoiceFilter consists of two parts trained separately:
  - The Speaker Encoder;
  - The VoiceFilter Network, which uses the output of the Speaker Encoder as an additional input.

Speaker Encoder

- The Speaker Encoder is nothing more than a speaker identification/verification system. In the context of VoiceFilter it is used to extract a compressed representation (a vector of size 256) of the speech characteristics of an speaker.
- We used a speaker encoder trained with the GE2E loss that was trained with Mel Spectrograms.
- Two versions: GE2E2k and GE2E3k
- Speaker encoder in the original work was trained with **many many** more hours !

VoiceFilter



Data Pre-processing

- Uses some Image Processing themes we have seen in class
- Mel Spectrograms
- Fourier Transforms

Experiments

- All experiments use the GE2E2k speaker encoder unless stated otherwise.
- Experiment 1 - Reproduces VoiceFilter, uses MSE as loss function.
- Experiment 2 - Reproduces VoiceFilter, and also uses the same loss function, Power-Law Compressed function.
- Experiment 3 - Reproduces VoiceFilter, uses SI-SNR as loss function.

Experiments

- Experiment 4 - Similar to Experiment 3, however additionally the ReLU activation function is replaced with the Mish activation function.
- Experiment 5 - Similar to Experiment 3, however we use the GE2E3k speaker encoder.

Results

Experiment	Avg SI-SNRi
VoiceFilter [Wang et al., 2018]	**10.55729**
1	6.02260
2	5.69875
3	5.66147
4	6.49116
5	**6.55238**

Demos

- Colab notebooks Demo:
  - Exp 1: https://shorturl.at/eBX18
  - Exp 2: https://shorturl.at/oyEJN
  - Exp 3: https://shorturl.at/bInEW
  - Exp 4: https://shorturl.at/qFJN8
  - Exp 5 (best): https://shorturl.at/kvAQ8
- Site demo for the best experiment:

  https://edresson.github.io/VoiceSplit/

Conclusions

- Although we could not reproduce Google's values as we lacked their data, we did find promising results about the use of the MSE loss function and Mish activation function.
- This may lead to the improvement of automatic speech recognition software and separating samples for populating data sets.

References

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