Increase Apparent Public Speaking Fluency by Speech Augmentation

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Introduction & Motivation:

Speech disfluency generally comes in the form of long pauses, discourse markers, repeated words, phrases or sentences and fillers or filled pauses like uh and um. Approximately 6% of speech appears to be non-pause disfluency [1]. **Filled pauses or filler-words are the most common disfluency in any unrehearsed, impromptu speech** [2].

Contributions:

- Filler-word detection on acoustic features.
- Silence classification conditioned on previous speech segment.
- Disfluency repair scheme to aid speakers.

Disfluency Detection:

Filler-word segmentation works using a Convolutional Recurrent Neural Network (CRNN) [3].

- Frame level acoustic features (log mel & MFCCs) are fed into Conv-MaxPool-ReLU blocks.
- Output features are stacked and fed into multiple Gated Recurrent Units (GRUs).
- FC-Softmax layer gives frame level probability.

Silences are classified into fluent and disfluent class.

- Training: Each silence is padded with previous and next word utterances and MFCC features are extracted to train a binary classifier.
- Testing: Around each silence a fixed length time window is used. 0.8-1.0 secs. works pretty well.

Disfluency Repair:

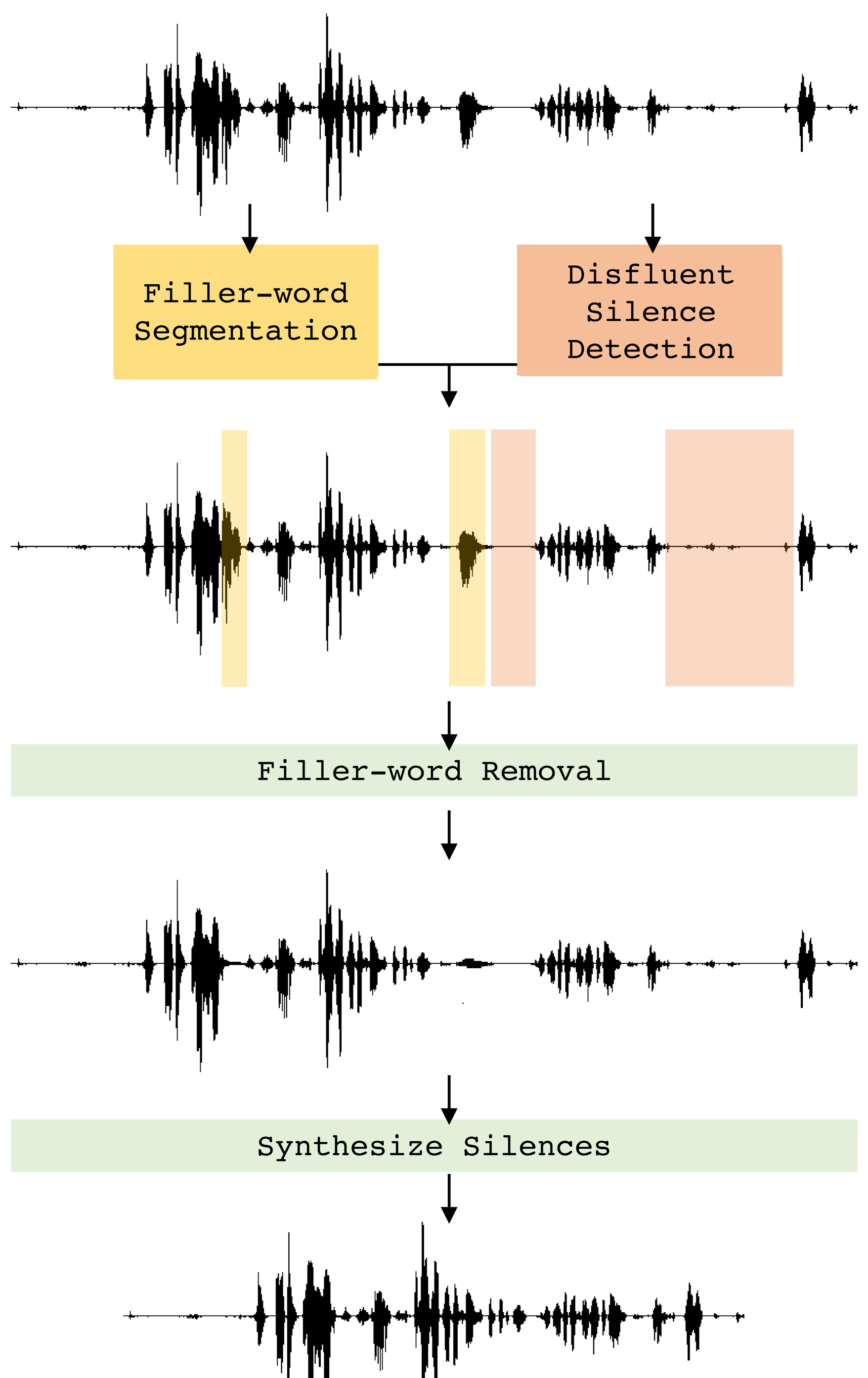
- All fluent silence durations are used to obtain a **histogram of fluent silences**.
- **Median of histogram bins** works well as optimal silence duration.
- Fillers and disfluent silences are **replaced with a silence of optimal duration**.

TL; DR

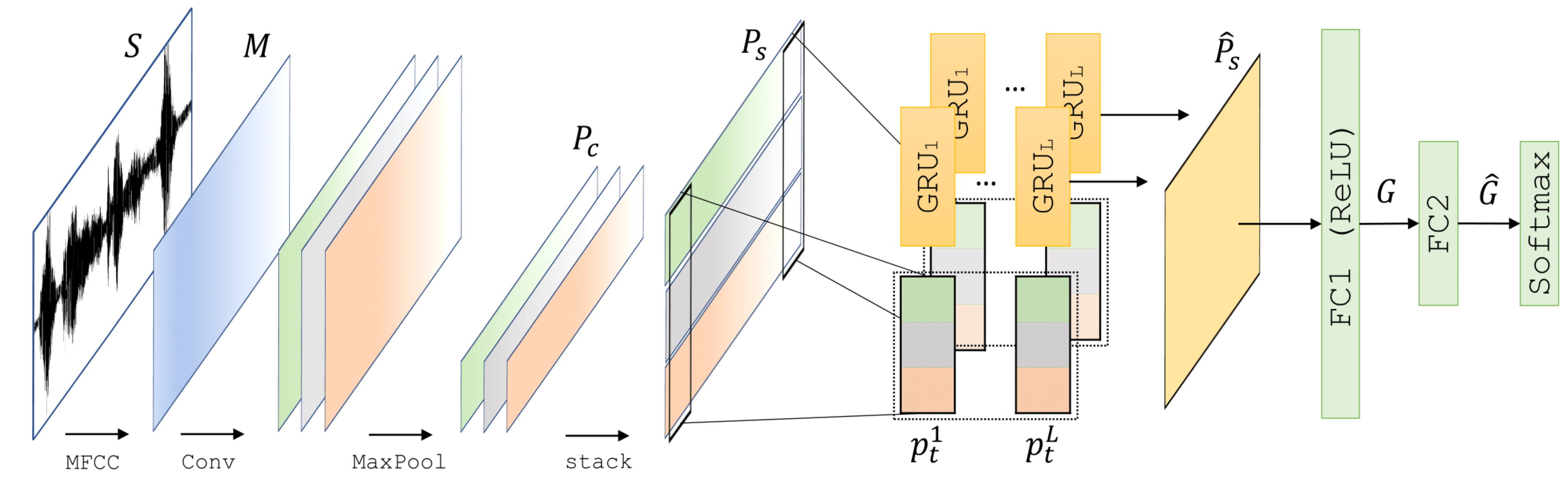
Everyone desires fluent & professional-like speech.

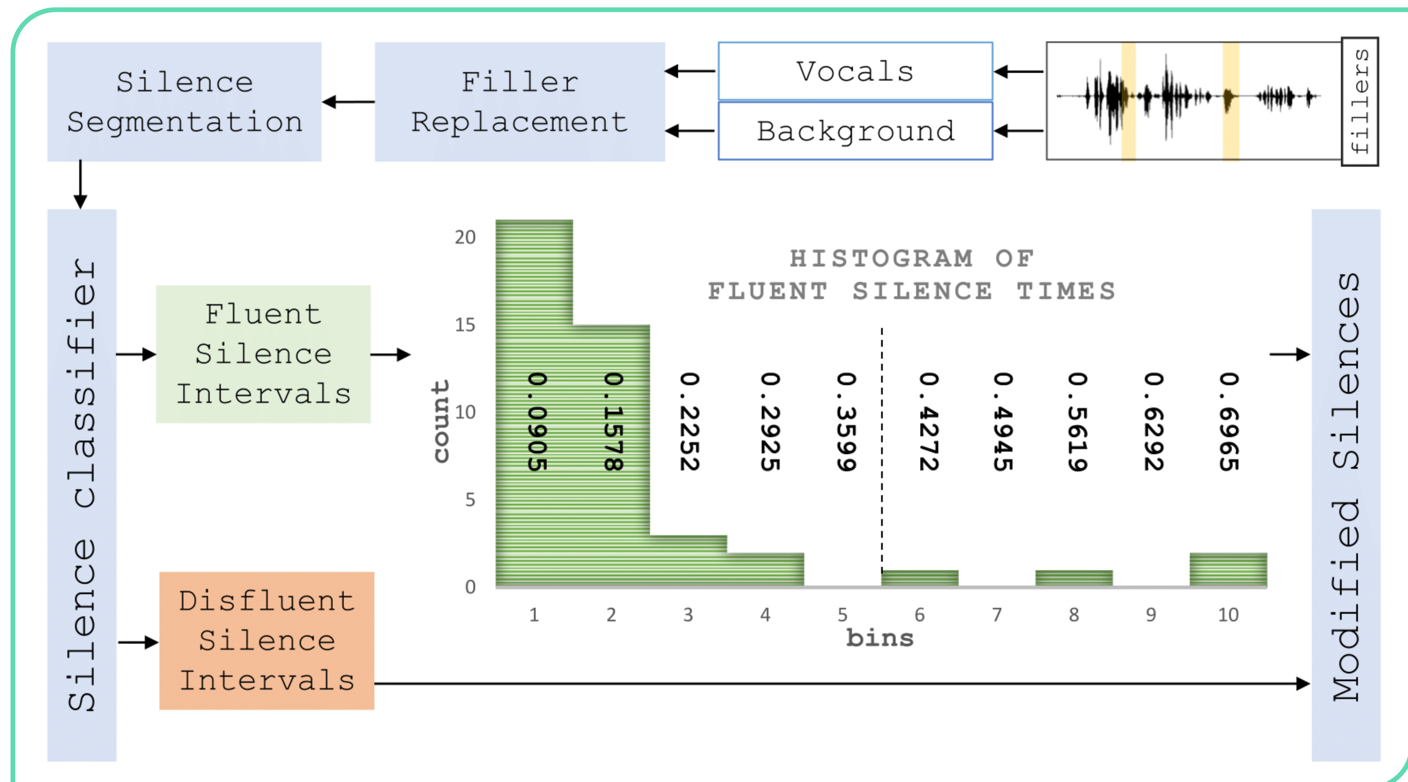
Our paper proposes a method to **detect** & **correct** common speech disfluencies, the **filler-words** (uh, umm), and **long pauses** to make the speaker more fluent.

We achieve this task by a learning based **filler word segmentation** & **silence classification** approach.



Some example outputs are available here!





Convolutional Recurrent Network (CRNN) based **filler-word segmentation**

Weakly-supervised silence classifier trained on fluent speech data. **Histogram based silence modification** allows to maintain speaker's pace.

Data:

- **TIMIT**: Silence classifier training. Silences are weakly-labeled using a probabilistic silence model [4] & disfluency detection model [5].
- **Switchboard I & II, AutoManner** : CRNN training and validation.

Experiments:

- **Validation of filler-word segmentation:**

Features	Precision	Recall	F1
MFCC	0.9482	0.9610	0.9534
Log Mel	**0.9495**	**0.9629**	**0.9550**

Method	Precision	Recall	F1
ASR	**0.9774**	**0.9792**	**0.9775**
CRNN	0.9495	0.9629	0.9550

- **Validation of silence classification:**

Method →	SVM (rbf)	Logistic Reg.	XGBoost
F1	**0.9774**	**0.9792**	**0.9775**

- **Disfluency repair quantitative Metrics** [6]: Speech rate (SR), Articulation rate (AR), Phonation-time ratio (PTR), Mean length of runs (MLR), Mean length of pauses (MLP) and Filled pauses per min. (FPM).

Metrics	SR ↑	AR ↑	PTR ↑	MLR ↑	MLP ↓	FPM ↓
Original	191.456	198.155	66.717	0.420	0.789	4.379
Proposed	206.465	208.437	**77.151**	0.495	**0.422**	1.813
+ASR	**206.710**	**208.770**	76.974	**0.504**	0.438	**1.608**

Future Works:

- Extension for other disfluencies.
- Generate silences instead replacing (GANs).

References:

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