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To cite this version:
Can Cui, Imran Ahamad Sheikh, Mostafa Sadeghi, Emmanuel Vincent. End-to-end Multichannel Speaker-Attributed ASR: Speaker Guided Decoder and Input Feature Analysis. Rencontre des Jeunes Chercheurs en Parole, Nov 2023, Grenoble, France. hal-04321252

HAL Id: hal-04321252
https://hal.science/hal-04321252
Submitted on 4 Dec 2023

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End-to-end Multichannel Speaker-Attributed ASR: Speaker Guided Decoder and Input Feature Analysis

Can Cui, Imran Sheikh, Mostafa Sadeghi, Emmanuel Vincent

Task
- Transcribe a multichannel multi-speaker meeting

Key challenges
- Complex audio signals containing overlapping speech, noise, and reverberation
- Information sharing between ASR and speaker identification modules
- Design of optimal training losses, regularization, and training schedules of the E2E model

Main contributions
- E2E Multichannel Speaker-Attributed ASR (MC-SA-ASR) system
- Impact of multichannel input features

Proposed methods: MC-SA-ASR
  - W1, W2, W3 <sc> W4, W5 where <sc> indicates speaker change

Proposed methods: Input features
- C x L x 4 x 32 x G/8
- C x L x 4 x 64 x G/4
- C x L x 2 x 32 x G/2
- C x L x 3 x 32 x 5, 2
- C x L x 1 x M
- Mel filterbank

Proposed methods: Convolution Fusion

Proposed methods: Multi-Frame Cross Channel Attention

Proposed methods: Speaker Guided Decoder and Input Feature Analysis

Experiments on LibriSpeech: Data preparation
- Data: LibriSpeech train-960, dev-clean, test-clean
- Preparation for multichannel multi-speaker setting on train-dev-test set: Room Impulse Responses simulated by the gpuRIR toolkit; Dynamic mixing for 2 and 3 speakers without duplication

Experiments on LibriSpeech: Results and discussion

<table>
<thead>
<tr>
<th>System</th>
<th>Input # Ch</th>
<th>1-spk WER (%)</th>
<th>2-spk mix WER (%)</th>
<th>3-spk mix WER (%)</th>
<th>4-spk mix WER (%)</th>
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Experiments on AMI: Data preparation
- Data: 100 hours of meeting data with 3–5 participants and 8–16 microphones
- Dividing each meeting (approximately 1 hour) into fixed-size chunks while avoiding speaker overlaps or cutting within a word
- The training and development sets consist of 5 s, 10 s, or 15 s chunks only. The test set comprises 5 s, 10 s, and 15 s chunks

Experiments on AMI: Results and discussion

Table: WER (%) and token-level SER (%) of models adapted to AMI.

<table>
<thead>
<tr>
<th>System</th>
<th>1-spk WER (%)</th>
<th>2-spk mix WER (%)</th>
<th>3-spk mix WER (%)</th>
<th>4-spk mix WER (%)</th>
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</table>

Conclusions
- WER reduction up to 16% relative on simulated data
- Phase features perform better on chunks with a larger number of channels and/or with a larger number of speakers

Perspectives
- Improve the speaker count accuracy on real data
- Make effective usage of multichannel phase features for a better localization of speakers

References