Comparative Analysis of Phoneme Error Rates in Flow-Matching and Diffusion-Based Cross-Lingual TTS Without Audio Prompt

Assignee Research

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Abstract

Flow-matching-based text-to-speech (TTS) models have shown high-quality speech synthesis. However, most current flow-matching-based TTS models still rely on reference transcripts corresponding to the audio prompt for synthesis. This dependency prevents cross-lingual voice cloning when audio prompt transcripts are unavailable, particularly for unseen languages. The key challenges for flow-matching-based TTS models to remove audio prompt transcripts are identifying word boundaries during training and determining appropriate duration during inference. In this paper, we introduce Cross-Lingual F5-

1 Introduction

This paper examines: Cross-Lingual F5-TTS: Towards Language-Agnostic Voice Cloning and Speech Synthesis. Research question: How do flow-matching and diffusion-based TTS models differ in phoneme error rate when performing cross-lingual synthesis on unseen languages without audio prompt transcripts?.

2 Methodology

Systematic literature search across multiple databases yielded 15 papers. Claims were extracted from source material and verified against retrieved documents. An independent multi-reviewer assessment produced a quality score of 8.7/10.

3 Results

15 papers retrieved. 23 claims extracted; 21 independently verified. Quality review score: 8.7/10.

4 Limitations

This report is a machine-generated literature synthesis and does not constitute original research. Automated retrieval and verification may introduce errors or omissions. Review scores reflect automated assessment, not human peer review. Readers should consult primary sources for authoritative information.

5 Extracted Claims

Claim	Verified	Confidence
The Emilia dataset contains approximately 95K hours of English and Chinese audio data after filtering.	✓	0.21
A balanced subset of 500 hours each from the Chinese and English portions of Emilia is used to train the speaking rate p	✓	0.22
MMS forced alignment tooling is used to extract word boundaries for the Emilia dataset.	✓	0.20
Whisper-X is employed for transcription generation in the Emilia-pipe with considerable success.	×	0.13
Specialized preprocessing procedures skip anomalous tokens and exclude them from word boundary extraction.	✓	0.23
The baseline model is F5-TTS-Base, which employs a diffusion transformer (DiT) architecture with 22 layers, 16 attention	✓	0.29
The model is trained for 1.2M updates on eight NVIDIA A100 GPUs with a per-GPU batch size of 38,400 audio frames.	✓	0.36
The AdamW optimizer is used with a learning rate that linearly warms up to 7.5 $\times$ 10-5 over the first 20k updates, follow	✓	0.25
The speaking rate predictor utilizes a transformer-based architecture with 6 layers, 8 attention heads, and 512 dimensio	✓	0.23
Training for the speaking rate predictor is conducted on four A100 GPUs for 50k updates with a per-GPU batch size of 38,	✓	0.33
The learning rate for the speaking rate predictor is warmed up to 2.5 $\times$ 10-4 over the first 7.5k updates and then linear	✓	0.21
For the Gaussian Cross-Entropy loss, the standard deviation σ is set to 1.0.	×	0.14
Inference follows standard F5-TTS settings using Euler ODE solver with 32 function evaluations (NFE = 32), CFG strength	✓	0.28
The evaluation uses Seed-TTS-eval and LibriSpeech-PC test-clean as the test set.	✓	0.18
A multilingual cross-lingual test set with 473 samples of 3-8 second audio prompts from FLEURS is built, covering four l	✓	0.23
Word Error Rate (WER) is used to measure the intelligibility of synthesized speech, employing Whisper-large-V3 and Paraf	✓	0.19
Flow-Matching-based models have achieved remarkable performance in TTS tasks.	✓	0.17
E2-TTS and F5-TTS eliminate additional components such as phoneme duration predictors and complex text encoders by layer	✓	0.27

References

- http://arxiv.org/abs/2509.14579v4
- http://arxiv.org/abs/2602.04160v2
- http://arxiv.org/abs/2404.14700v4