Timi:Speech generation with Tacotron and MelGAN

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***Abstract*—In this project, we present a system that directly generates natural human speech from text using neural network models. Traditional TTS pipelines consist of multiple components, such as text analysis, acoustic modeling, and vocoding, which require extensive feature engineering and manual alignment. In contrast, our system combines Tacotron as a sequence-to-sequence model that converts text into mel-spectrograms, and MelGAN as a neural vocoder that transforms the spectrograms into waveforms. The entire pipeline can be trained or fine-tuned from paired ¡text, audio¿ data without phoneme-level annotations. We used the open-source LJSpeech dataset and implemented the system in PyTorch. We further compare MelGAN with the traditional Griffin-Lim vocoder to demonstrate perceptual quality improvements. This work illustrates how end-to-end neural architectures can significantly simplify TTS design, reduce dependency on expert knowledge, and provide a reproducible baseline for researchers interested in neural speech synthesis.**

***Index Terms*—TTS, Tacotron, MelGAN, speech syunthesis.**

I. Introduction

II. Problem Description

Text-to-speech synthesis aims to convert textual input into natural-sounding speech. Traditional systems require multiple stages such as linguistic feature extraction, duration modeling, and waveform synthesis, leading to high complexity and limited scalability. Recent deep learning advancements allow speech generation to be modeled directly from data. This project explores a fully end-to-end neural TTS system that eliminates the need for manually engineered features or phoneme alignments. By combining Tacotron (for text-to-mel conversion) and MelGAN (for mel-to-waveform synthesis), we aim to build a system that generates intelligible, high-quality speech from raw text. Our research questions include:

1. Can a simplified Tacotron + MelGAN pipeline achieve competitive audio quality with minimal tuning?

2. How does MelGAN compare with Griffin-Lim in terms of naturalness and inference speed?

3. What are the trade-offs between model complexity and reproducibility?

III. Related Works

IV. Proposed Methods

V. Experimental Setup

A. DataSets

LJSpeech Dataset: A public English single-speaker dataset (13,100 audio clips, 24 hours total). Sampling rate: Each audio file has a corresponding normalized text transcript. Data split:

B. Model Architecture

Model Architecture Tacotron2: MelGAN Vocoder: Generator: fully convolutional upsampling network conditioned on mel-spectrograms. Multi-scale discriminators: enforce adversarial loss for realistic audio texture. Loss: adversarial + feature matching loss.

The models are trained sequentially — first Tacotron, then MelGAN — using PyTorch and Adam optimizer.

Training Parameters

Tacotron2: batch size = learning rate = , , iterations.

MelGAN: batch size = , learning rate = , trained for steps.

GPU: .

Training time: Tacotron2 ; MelGAN .

C. Evaluation Metrics

Objective Metrics:

Mel Cepstral Distortion (MCD): is an objective measure that quantifies the difference between a generated speech signal and a reference (ground truth) signal in the mel-cepstral domain.It computes how close the synthetic speech spectrum is to the real one. A lower MCD value indicates that the synthesized speech is more similar to the natural recording and therefore of better quality. In practice, MCD is measured in decibels (dB) and commonly used to evaluate spectral accuracy in TTS systems.

Subjective Metrics:

Mean Opinion ScoreOS (MOS) [1]: is a subjective evaluation metric that reflects how natural and pleasant the synthesized speech sounds to human listeners. In an MOS test, participants listen to several audio samples and rate them on a five-point scale, where 1 = “Bad” and 5 = “Excellent.” The final MOS value is the average of all listener ratings. A higher MOS means that listeners perceive the speech as more natural, clear, and human-like.

Efficiency Metrics: Real-time factor (RTF) for inference speed: is an efficiency metric that measures how fast the system can generate speech relative to real time. It is defined as the ratio between synthesis time and audio duration.For example, an RTF of 0.5 means that the model can generate 1 second of speech in 0.5 seconds — faster than real time. A lower RTF indicates higher synthesis speed, which is essential for applications such as interactive systems or game voice synthesis.

D. Results

E. Discussions and Conclusions

F. Abbreviations and Acronyms

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, ac, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

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Number equations consecutively. To make your equations more compact, you may use the solidus (/), the exp function, or appropriate exponents. Italicize Roman symbols for quantities and variables, but not Greek symbols. Use a long dash rather than a hyphen for a minus sign. Punctuate equations with commas or periods when they are part of a sentence, as in:

$$a + b = \gamma \tag{1}$$

Be sure that the symbols in your equation have been defined before or immediately following the equation. Use "(1)", not "Eq. (1)" or "equation (1)", except at the beginning of a sentence: "Equation (1) is . . ."

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Please don't use the `{eqnarray}` equation environment. Use `{align}` or `{IEEEeqnarray}` instead. The `{eqnarray}` environment leaves unsightly spaces around relation symbols.

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J. Some Common Mistakes

- The word "data" is plural, not singular.
- The subscript for the permeability of vacuum μ_0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter "o".
- In American English, commas, semicolons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)
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- Do not use the word "essentially" to mean "approximately" or "effectively".
- In your paper title, if the words "that uses" can accurately replace the word "using", capitalize the "u"; if not, keep using lower-cased.

- Be aware of the different meanings of the homophones “affect” and “effect”, “complement” and “compliment”, “discreet” and “discrete”, “principal” and “principle”.
- Do not confuse “imply” and “infer”.
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- There is no period after the “et” in the Latin abbreviation “et al.”.
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L. Identify the Headings

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Component heads identify the different components of your paper and are not topically subordinate to each other. Examples include Acknowledgments and References and, for these, the correct style to use is “Heading 5”. Use “figure caption” for your Figure captions, and “table head” for your table title. Run-in heads, such as “Abstract”, will require you to apply a style (in this case, italic) in addition to the style provided by the drop down menu to differentiate the head from the text.

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TABLE I
TABLE TYPE STYLES

Table Head	Table Column Head		
	Table column subhead	***Subhead***	***Subhead***
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[a]Sample of a Table footnote.

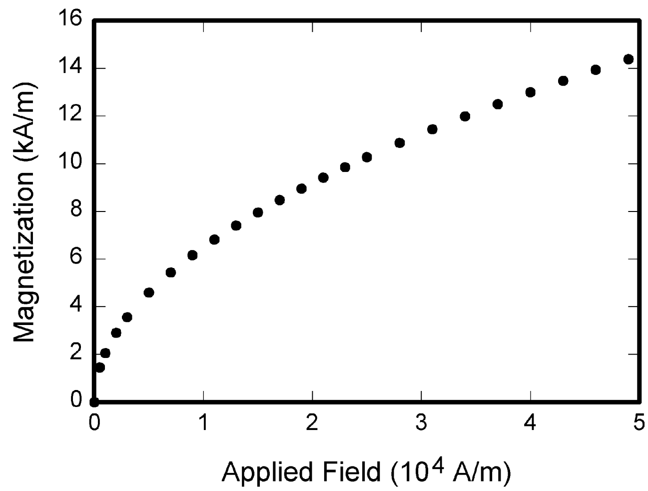

Fig. 1. Example of a figure caption.

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ACKNOWLEDGMENT

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REFERENCES

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