

Draw Your Own Vowel Chart

(11th Seminar for Intern-3)

Ye Kyaw Thu
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Contents

1. Introduction to Phonetics
2. Praat
3. Preparing Vowels
4. Recording
5. Formant Tracking
6. Annotation
7. Annotated Spectrum to F1, F2, F3
8. Coding for Drawing Vowel Chart
9. Conclusion

Introduction to Phonetics (Burmese)

The London Phonetic Readers

A BURMESE PHONETIC READER

WITH ENGLISH TRANSLATIONS

BY
LILLIAS E. ARMSTRONG, B.A.

SENIOR LECTURER IN PHONETICS
AT UNIVERSITY COLLEGE, LONDON;

AND

PE MAUNG TIN
M.A. (CALCUTTA), B.LITT. (OXON),

INDIAN EDUCATIONAL SERVICE, PROFESSOR
OF PĀLI, UNIVERSITY COLLEGE, RANGOON.

LONDON
UNIVERSITY OF LONDON PRESS, LTD.
17 WARWICK SQUARE, E.C. 4
1925

- ပါမောက် ကောတနေး၏
ဖိန်းသံအုပ်ရိကျိုးထွက်ပေါ်လာပြီး
နောက် မြန်မာဘာသာစကားကို
ဖိန်း ဟူသော
သဘောတရားနှင့်လွှဲလာတင်ပြသ
ည် ပထမဦးဆုံးသော
လွှဲ သုတေသနလုပ်ငန်းအဖြစ်
မတ်ယူနိုင်ပါသည်။
- ငြင်းစာအုပ်ကို ဆရာတိုးရွှေသွင်
(၁၉၂၅) မြန်မာပြန်သည်။
ဆရာတိုးသိန်းထွန်း လေလိုင်းသဒ္ဓမေဒ္ဒန် မြန်မာစကားသံ
ပြောင်းလဲမှစနစ် စာအုပ်တွင် အထက်ပါအတိုင်း
ဖော်ပြထားသည်။

Introduction to Phonetics (Burmese)

THE TYPE OF PRONUNCIATION

The pronunciation represented is that of Mr. Pe Maung Tin (-phe: _maʊ̯ _tī:), who has prepared the texts and the translations. His speech is typical of that spoken by the educated classes of Lower Burma.

A double-sided gramophone record (No. C 1181) of texts 5, 8, 9, 12, 13, and 14, spoken by Mr. Tin, may be obtained from the Gramophone Company, 363 Oxford Street, London, W.1, and from their agents.

Introduction to Phonetics (Burmese)



- 363 Oxford Street, London
- Gramophone Company
- His Master's Voice Symbol

By Alex Liivet from Bournemouth, United Kingdom - HMV Oxford Street, CC BY 2.0, <https://commons.wikimedia.org/w/index.php?curid=39170107>

Introduction to Phonetics (Burmese)

I. Oral Vowels

(a) *Pure Vowels.* These are represented by the following symbols.—

1. *i* as in 'si: (*to ride*)

i (chief subsidiary member of the *i*-phoneme) as in 'si? (*war, battle*).

2. *e* as in 'pe: (*to give*).

er (chief subsidiary member of the *e*-phoneme) as in 'per? (*to shut*).

3. *ɛ* as in _le: (*field*).

4. *a* as in _ba: (*please*).

a (chief subsidiary member of the *a*-phoneme) as in 'la? (*fresh*).

ə is used in unstressed positions in the place of *a, ε, i, u*, etc. Further research may prove that *ə* is a separate phoneme. For the present it may be considered as attached to the *a*-phoneme.

5. *ɔ* as in 'so: (*early*).

6. *o* as in 'po: (*silk*).

ou (chief subsidiary member of the *o*-phoneme) as in 'pou? (*putrid*).

7. *u* as in _ku: (*to help*).

v (chief subsidiary member of the *u*-phoneme) as in 'ku? (*to kill*).

(b) *Diphthongs.* Represented thus:—

8. *ai* as in 'mar? (*stupid*).

9. *au* as in 'laʊ? (*enough*).

Four other diphthongs which have a nasal element are given under Nasalized Vowels.

II. Nasalized Vowels

Represented thus:—

10. *ĩ* as in _wĩ: (*to enter*).

11. *eĩ* „ *seĩ* (*diamond*).

12. *aĩ* „ *'paĩ* (*to divide*).

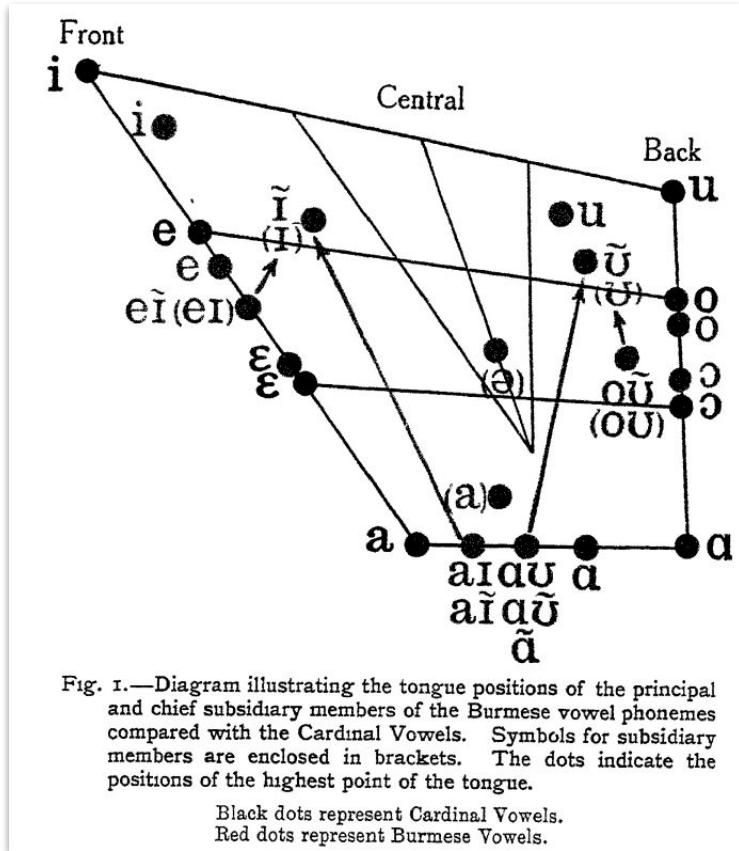
13. *ã* „ *'pã:* (*a flower*).

14. *õ* „ *'sõ'* (*to risk*).

15. *aõ* „ *'saõ'* (*to wart*).

16. *oõ* „ *'poõ* (*to hide*).

Introduction to Phonetics (Burmese)



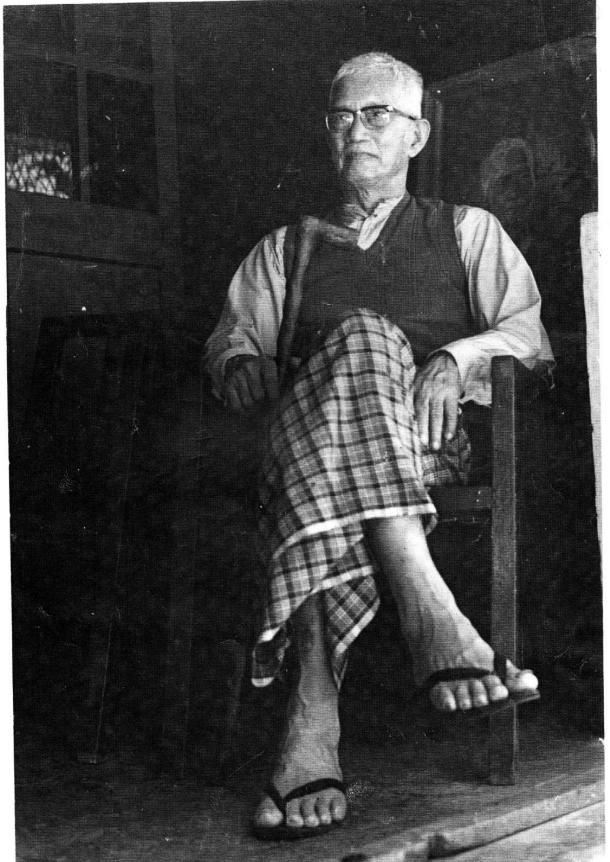
- ဒီ vowel chart က
လျေလာရသလောက်
မြန်မာစာအတွက် ပထမဆုံးလို့ ယူဆ
- ဆရာမကြီး: Lilias Eveline Armstrong
နှင့် ဆရာကြီး ဦးဖေမောင်တင်တို့ရဲ့
သုတေသန အလုပ်ပါ
- ဒီနေ့ ဆရာ lecture
ကိုနားထောင်ပြီးရင် ဒီ vowel chart
ပုံကုံ ပြန်ဆုံးကြည့်ကြရအောင်

Introduction to Phonetics (Burmese)



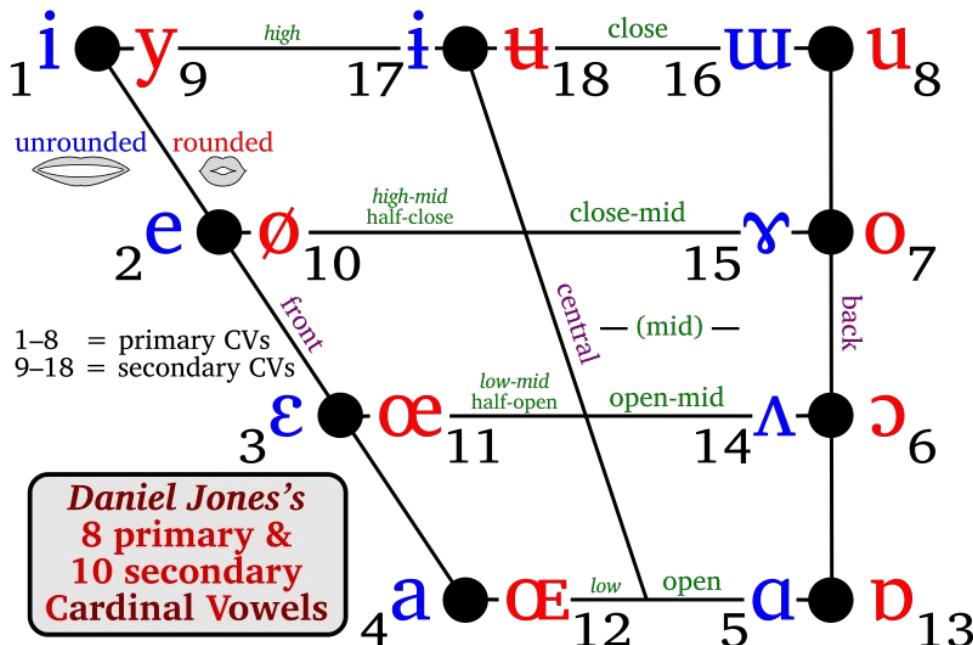
- English Phonetician Lilias Eveline Armstrong (29 September 1882 – 9 December 1937)
- She worked at University College London, where she attained the rank of reader.
- Armstrong is most known for her work on English intonation as well as the phonetics and tone of Somali and Kikuyu.
- Her book on English intonation, written with Ida C. Ward, was in print for 50 years.
- https://en.wikipedia.org/wiki/Lilias_Armstrong

Introduction to Phonetics (Burmese)



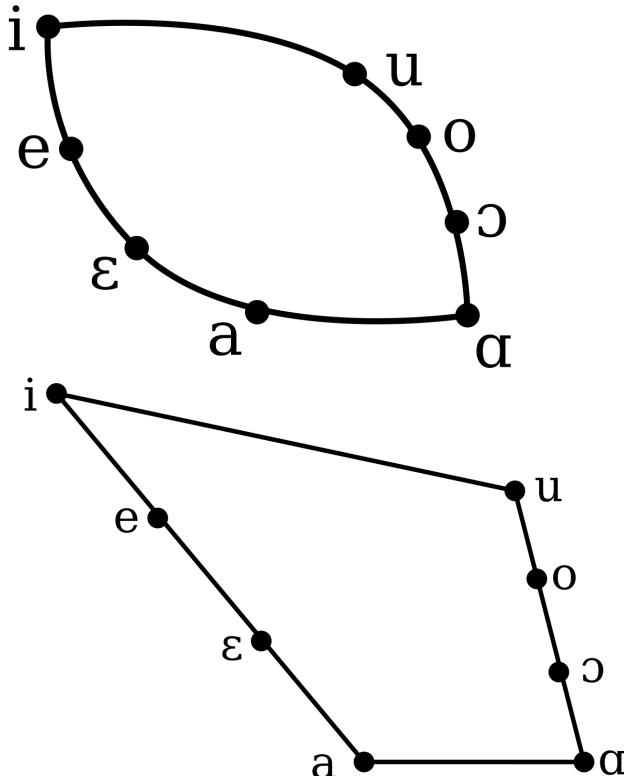
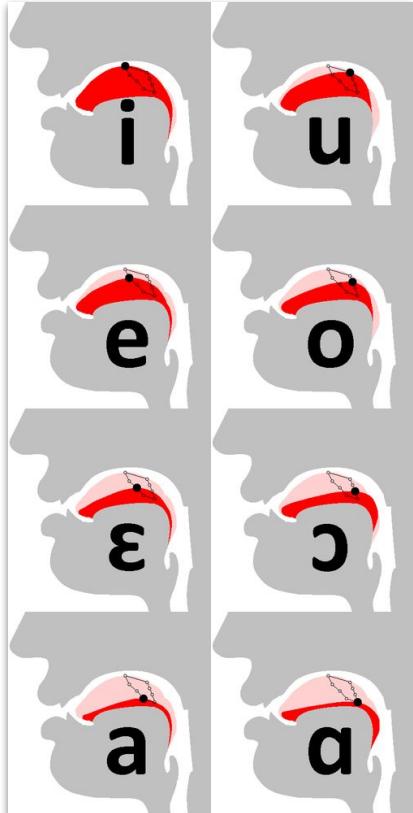
- ဦးဖေမောင်တင် သည် မြန်မာနိုင်ငံသား မြန်မာဘာသာနှင့် ပါဒ္ဓဘာသာ ပညာရှင်၊ စာရေးဆရာ၊ တက္ကသုလ်ပါမောက္ခတစ်ဦး ဖြစ်သည်။
- မြန်မာ့သမိုင်း၊ ရာဇဝင်များ၊ ဗုဒ္ဓဘာသာကျမ်းစာအချုပ်၊ ကုခိုင်၊ အဂါလီပိဘာသာသိပိနဲ့ခဲ့သောသူ မြန်မာစာပေကို တက္ကသုလ်တွင် အဆင့်မြိမ် သင်ကြားနိုင်သည် အခြေအနေသုရောက်အောင် အားထုတ်ကြုံးပမ်းခဲ့သော ဆရာကြိုးတစ်ဦး
- မြန်မာနှင့်တော် ပထမဆုံးတက္ကသုလ်ဖြစ်သော ရန်ကုန်တက္ကသုလ်၌ မြန်မာအမျိုးသားထဲမှ ပထမဆုံး ခန့်အပ်ခဲ့သော ပါမောက္ခ
- <http://bios.myanmar-institut.org/2019/01/31/p-e-maung-tin-1888-1973/>

Introduction to Phonetics (Vowels)



- A cardinal vowel is a vowel sound produced when the tongue is in an extreme position, either front or back, high or low.
- The current system was formulated by Daniel Jones in the early 20th century,[1] though the idea goes back to earlier phoneticians, notably Ellis and Bell.

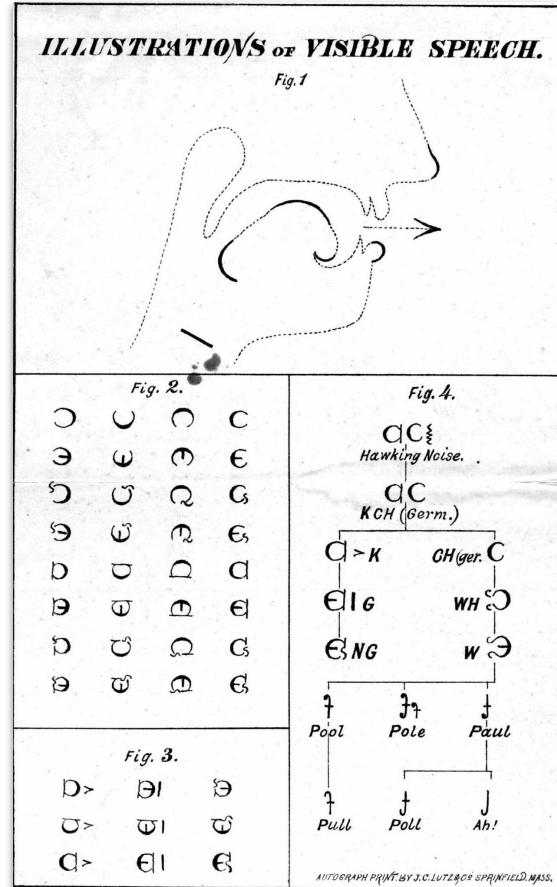
Introduction to Phonetics (Vowels)



- အသံထုတ်တဲ့အခါ
စကားပြောတဲ့အခါမှာ
လျှော့အမြင်ဆုံး
ပွဲငွေ့ကု ချိတ်ပြီး
ဆွဲပြထားတဲ့
သဘောပါ
- အများစု
ပုံဆွဲကြတဲ့အခါမှာ
အောက်ပါ
ပုံစမျိုးပိုမြင်ရလိမ့်မှ
ယ်

Introduction to Phonetics (Vowels)

- **Iconic notation:** Character shapes visually represent vocal tract articulator positions.
- **Alphabetic notation:** No visual link between shapes and articulation.
- **Advantage:** More flexible in showing pronunciation nuances (MacMahon 1996).
- **Example:** Alexander Melville Bell's Visible Speech (Ellis 1869).
- https://en.wikipedia.org/wiki/Phonetic_transcription



Introduction to Phonetics (IPA)



International Phonetic Association

ɪntə'naʃənəl fe'nɛtɪk ə'sousi'eʃn

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User Menu

- Members' Portal



Become a member of the IPA to receive copies of JIPA, and to get access to the online version.

The International Phonetic Alphabet and the IPA Chart

The official International Phonetic Alphabet, and its organization in a chart, is maintained by the Association. As noted in our 1999 [Handbook](#) (Appendix 4), modifications have always been the result of "members making proposals for changes, which were published in the journal and voted on by the Association's Council" (p. 196). Only changes to the alphabet or chart that have been approved by the Council can be considered part of the official IPA. For further information, please consult the [Secretary](#).

Reproduction of The International Phonetic Alphabet

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Introduction to Phonetics (IPA)

THE INTERNATIONAL PHONETIC ALPHABET (revised to 2015)

CONSONANTS (PULMONIC)

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b		t d	t̪ d̪	c j	k g	q G		?		
Nasal	m	m̪	n	n̪	jn̪	ŋ		N			
Trill	B		r					R			
Tap or Flap		v̪	f	t̪							
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ɟ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative			ɬ ɭ								
Approximant		v̪	ɹ	ɻ	j	ɻ					
Lateral approximant			l̪	ɬ̪	ɻ̪	ɬ̪					

Symbols to the right in a cell are voiced, to the left are voiceless. Shaded areas denote articulations judged impossible.

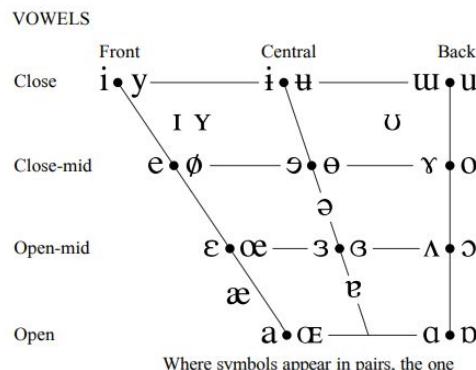
CONSONANTS (NON-PULMONIC)

Clicks	Voiced implosives	Ejectives
ʘ Bilabial	b Bilabial	,
Dental	d Dental/alveolar	Examples: p' Bilabial
! (Post)alveolar	f Palatal	t' Dental/alveolar
# Palatoalveolar	g Velar	k' Velar
Alveolar lateral	g' Uvular	s' Alveolar fricative

OTHER SYMBOLS

ʍ Voiceless labial-velar fricative

ç Z Alveolo-palatal fricatives



- **The IPA:** The oldest and leading organization for phoneticians.
- **Founded:** 1886 in Paris (130 years in 2016).
- **Milestone:** 2018 marked 130 years since the IPA alphabet's first publication.

Introduction to Phonetics (IPA)

OTHER SYMBOLS		Open			
M	Voiceless labial-velar fricative	ç z	Alveolo-palatal fricatives	aœ	aœ
W	Voiced labial-velar approximant	j	Voiced alveolar lateral flap	æ	æ
ɥ	Voiced labial-palatal approximant	ɸ	Simultaneous f and X	ɔ	ɔ
H	Voiceless epiglottal fricative				
ʕ	Voiced epiglottal fricative		Affricates and double articulations can be represented by two symbols joined by a tie bar if necessary.		
χ	Epiglottal plosive	ts	kp		
DIACRITICS Some diacritics may be placed above a symbol with a descender, e.g. i᷑					
o	Voiceless	n̪ d̪	Breathy voiced	b̪ a̪	Dental t̪ d̪
v	Voiced	ʂ t̪	Creaky voiced	b̪ a̪	Apical t̪ d̪
h	Aspirated	t̪ʰ d̪ʰ	Lingualabial	t̪ d̪	Laminal t̪ d̪
,	More rounded	ɔ̄	W Labialized	tʷ dʷ	Nasalized ē
c	Less rounded	ɔ̄	j Palatalized	tj̄ dj̄	Nasal release d̄n
+	Advanced	ɥ̄	Y Velarized	tʸ̄ dʸ̄	Lateral release d̄l
=	Retracted	ē	↖ Pharyngealized	t↖ d↖	No audible release d̄'
..	Centralized	ë̄	~ Velarized or pharyngealized	t̄	
x	Mid-centralized	ě̄	Raised	ē (j̄ = voiced alveolar fricative)	
,	Syllabic	n̄	Lowered	ē (β̄ = voiced bilabial approximant)	
~	Non-syllabic	ɛ̄	Advanced Tongue Root	ɛ̄	
~	Rhoticity	ə̄ ā	Retracted Tongue Root	ɛ̄	

Where symbols appear in pairs, the one to the right represents a rounded vowel.

SUPRASEGMENTALS

- ‘ Primary stress founə'tjuʃən
- ‘ Secondary stress
- ‘ Long e:
- ‘ Half-long e·
- ‘ Extra-short ē
- ‘ Minor (foot) group
- ‘ Major (intonation) group
- ‘ Syllable break .i.ækt
- ‘ Linking (absence of a break)

TONES AND WORD ACCENTS

LEVEL	CONTOUR
é or ē or ↗ Extra high	↗ Rising
é High	↘ Falling
ē Mid	↑ High rising
è Low	↓ Low rising
ë Extra low	↗ Rising-falling
↓ Downstep	↗ Global rise
↑ Upstep	↘ Global fall

- The IPA is a universal, precise system for transcribing speech sounds.
- It's not a writing system, but a tool to accurately represent pronunciation in any language.

Introduction to Phonetics (IPA)

The chart is divided into:

- Consonants (pulmonic), အဆုပ်ကတွန်းထူတ်လိုက်တဲ့ လေနဲ့ ပြောတဲ့ ဗျဉ်း
- Consonants (non-pulmonic), အဆုပ်ကလေကိုမသုံးတဲ့ ဗျဉ်းသံ
- Other symbols (rare/complex consonants)
- Vowels
 - Height: Close (top), Open (bottom)
 - Backness: Front → Central → Back
 - Roundedness: Left symbol unrounded, right symbol rounded
- Diacritics (Voiceless, Aspirated, Nasalized vowel, More rounded vowel, Raised/lowered)
- Suprasegmentals (stress, tone, length, etc.)

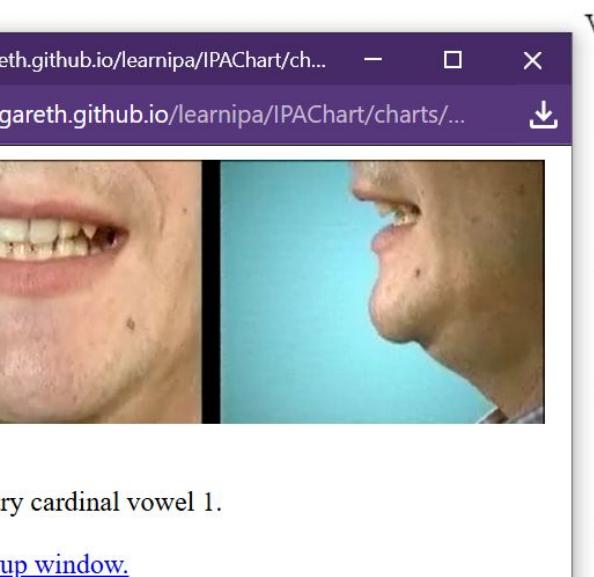
Introduction to Phonetics (IPA)

Applications of IPA

- Linguistics research – precisely describing sounds of any language
- Language teaching – showing learners exact pronunciation
- Dictionaries – e.g., /fəˈnɛtɪks/
- Speech therapy – documenting speech disorders
- Computational linguistics – G2P, TTS, ASR
- Fieldwork – recording endangered languages

Introduction to Phonetics (IPA)

[Back to main chart.](#)



The screenshot shows a web page with a purple header containing navigation icons and the URL walkergareth.github.io/learnipa/IPAChart/charts/vowels.html. Below the header is a link to "Back to main chart." On the left, there are two photographs: one of a person's mouth from the front showing teeth, and another from the side showing the profile of the mouth. To the right of these images is a vowel chart titled "VOWELS". The chart is arranged in four horizontal rows labeled "Close", "Close-mid", "Open-mid", and "Open" from top to bottom. The vertical axis is labeled "Front" on the left, "Central" in the middle, and "Back" on the right. The symbols are as follows:

	Front	Central	Back
Close	i • y I Y	ɪ • ʊ ə	u
Close-mid	e • ɸ ɛ	ə • θ œ	ʌ
Open-mid	æ	ɔ • ɒ ɑ	ɒ
Open	a • ɔE	ʌ	ɒ

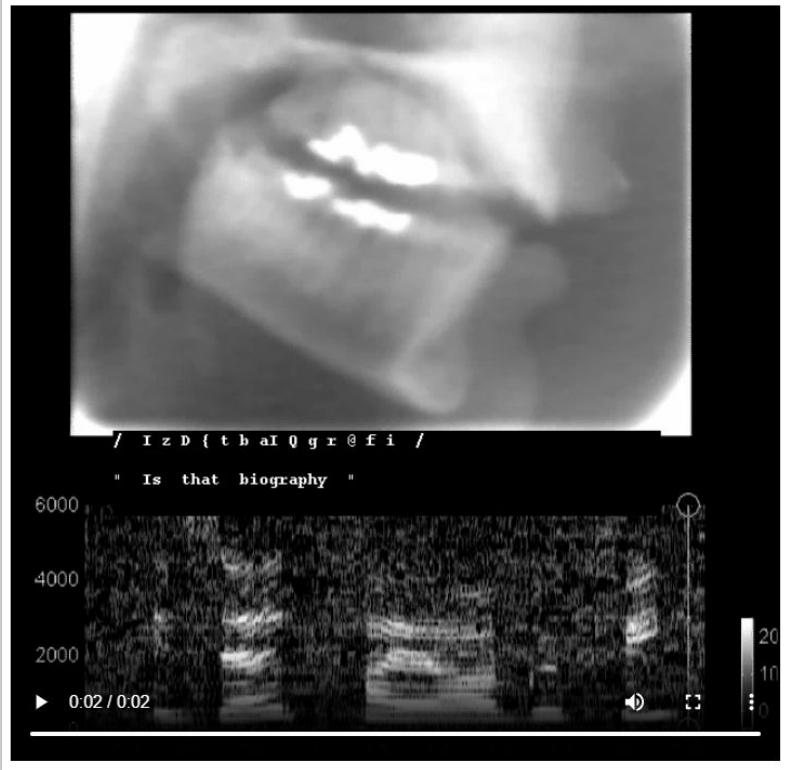
A note at the bottom right states: "Where symbols appear in pairs, the one to the right represents a rounded vowel."

<https://walkerqareth.github.io/learnipa/IPAChart/charts/vowels.html>

Introduction to Phonetics (xray demo)

F1. “Is that biography?” (/ I z D { t b al Q g r @ f i /)

[Open movie l80_11 in separate tab](#)

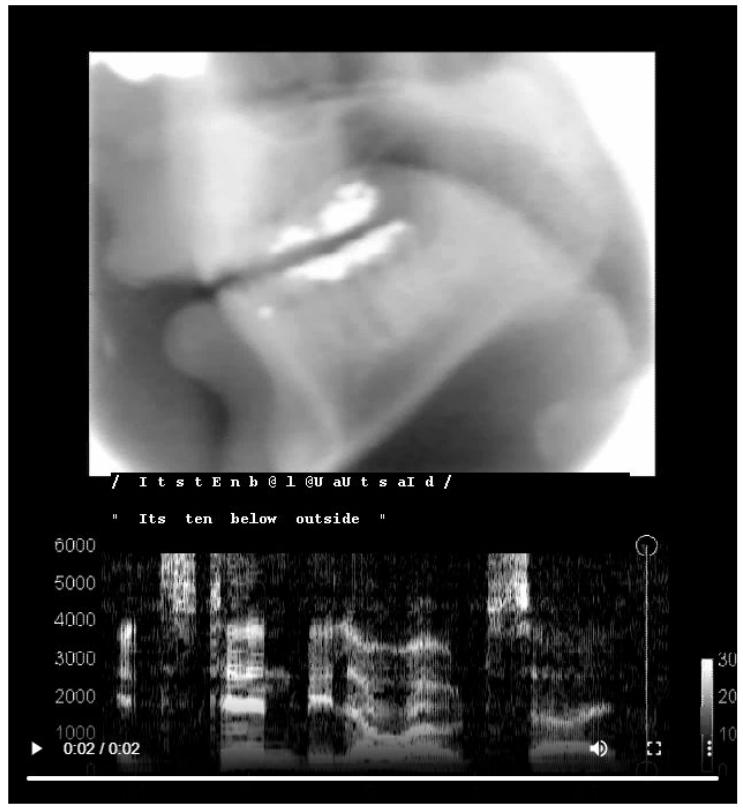


- https://www.phonetik.uni-muenchen.de/~hoole/kurse/movies/xray/xray_demo.html
- F1. “Is that biography?” (/ I z D { t b al Q g r @ f i /)

Introduction to Phonetics (xray demo)

M1. "Its ten below outside" (/ I t s t E n b @ l @ U aU t s aI d /)

[Open movie 177_04 in separate tab](#)



- https://www.phonetik.uni-muenchen.de/~hoole/kurse/movies/xray/xray_demo.html
- M1. "Its ten below outside" (/ I t s t E n b @ l @ U aU t s aI d /)

Introduction to Phonetics (3D simulation)

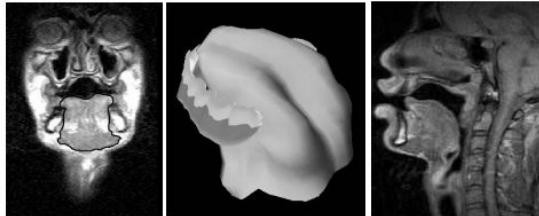


KUNGL
TEKNISKA
HÖGSKOLAN

Royal Institute of Technology
Speech, Music and Hearing

Tongue Talking

Studies in Intraoral Speech Synthesis



Olov Engwall

Doctoral Dissertation
Stockholm 2002

- Tongue Talking, doctoral thesis,
Olov Engwall, 2002

Introduction to Phonetics (3D simulation)

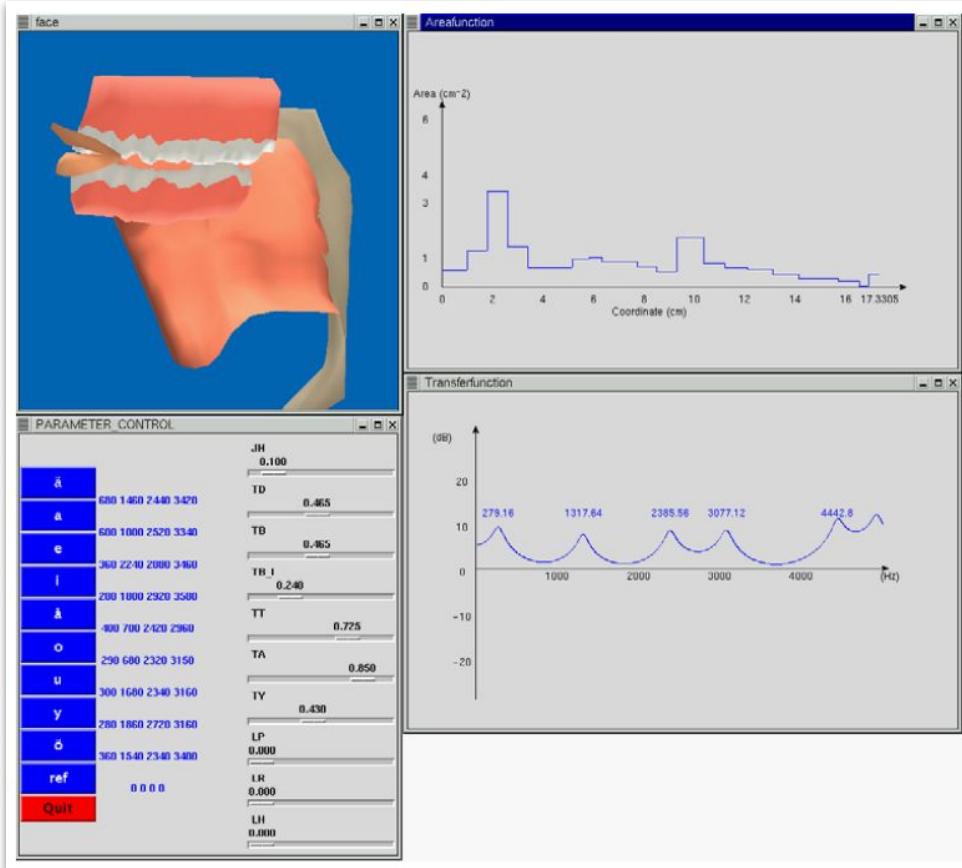


Fig. The graphical interface for the interactive articulatory synthesis, consisting of one window for the vocal tract model, one for the parameter and phoneme control, one for the area function and one for the transfer function.

Introduction to Phonetics (3D simulation)



(a) Front view

(b) Half face

(c) From behind

Figure 3.14. Three different views of the intraoral parts of the KTH synthetic head that could potentially be used in pronunciation training, a) with a see-through face, b) with one half of the face removed and c) from behind, with the hair removed.

- Tongue Talkin, doctoral dissertation, Olov Engwall
- <https://www.diva-portal.org/smash/get/diva2:9174/FULLTEXT01.pdf>

Fig. Three different views of the intraoral parts of the KTH synthetic head that could potentially be used in pronunciation training, a) with a see-through face, b) with one half of the face removed and c) from behind, with the hair removed

Introduction to Phonetics (3D simulation)

Fig. The difference between naive and expert listeners in the confusion matrix for the model's vowels. Stimuli horizontally and response vertically.

	i:	e:	æ:	a:	ɔ:	u:	ɯ:	y:	ø:	Total
i:	6							3	1	10
e:	1	-2								-1
æ:			-3							-3
a:		1		-1						0
ɔ:				1	0					1
u:						0	1			1
ɯ:							-2	8	4	10
y:	-7							-11		-18
ø:		1	3			1			-5	0

Introduction to Phonetics (Example Demo Application)

github.com/ye-kyaw-thu/myG2P

README.md

Update README.md

1 year ago

README

myG2P

Myanmar (Burmese) Language Grapheme to Phoneme (myG2P) Conversion Dictionary for speech recognition (ASR) and speech synthesis (TTS).

မြန်မာလိုဂတ်မယ်ဆိုရင် --> [README in Myanmar Language](#)

Lincense

Creative Commons Attribution-NonCommercial-Share Alike 4.0 International (CC BY-NC-SA 4.0) License
[Details Info of License](#)

Contact email: wasedakuma[at]gmail.com

Introduction

We developed this myG2P (Myanmar Grapheme-to-Phoneme) dictionary for [VoiceTra](#) (Multilingual Speech Translation Application) Myanmar language project of [NICT](#), Japan (during 2014-2015). We mainly used MLC (Myanmar Language Commission) dictionary words. Please cite the [ICCA 2015 paper](#) and/or [COLING 2016 paper](#),

- Version 2 ကျမ္မ IPA symbol ကုတ်ထပ်ဖြည့်တယ်အမိက
- ကူညီပေးခဲ့တာက YTU, Yangon စာရွှေကျောင်းသူတွေပါ (မန်ထေးအောင်၊ ဝင့်သံမြို့ဝင့်သံကာ ရွှေစင်မြို့...)

Introduction to Phonetics (Example Demo Application)

- စက်ရှပ်သံ TTS ဒီမို့ လုပ်ပြုမယ်
- Linux မှာ ရှိတဲ့ espeak နဲ့ myG2P ကိုပဲ သုံးပြီး လုပ်လို့ ရတယ်
- myG2P က IPA ကို ယူမယ်
- တခုရုံးတာက myG2P ရဲ့ IPA က တချို့ကို ဆရာတို့ modify လုပ်တာ၊
ထပ်ဖြည့်တာမျိုး လုပ်ထားတာမှို့
- အဲဒါကြာင့် Mapping တချို့ ဖြည့်လုပ်ဖို့ လိုအပ်တယ်
- Python နဲ့ coding လုပ်လုံကရင် ဒေမူ TTS ရပြီ
- လက်ရှိ လုပ်ထားတာက espeak ရဲ့ English အသံ ဥပဒေတွေကိုပဲ
အခြေခံပြီး လုပ်ပြထားတာ ဖြစ်တယ်

Introduction to Phonetics (Example Demo Application)

```
1 IPA_TO_ESPEAK = {
2     # Standard IPA consonants
3     'p': 'p', 'b': 'b', 't': 't', 'd': 'd', 'k': 'k', 'g': 'g',
4     'm': 'm', 'n': 'n', 'ŋ': 'N', 'f': 'f', 'v': 'v', 'θ': 'T',
5     'ð': 'D', 's': 's', 'z': 'z', 'ʃ': 'S', 'ʒ': 'Z', 'h': 'h',
6     'tʃ': 'ts', 'dʒ': 'dz', 'l': 'l', 'r': 'r', 'j': 'j', 'w': 'w',
7     'š': 's', 'ž': 'z', 'ň': 'J', 'ň': 'K', 'ň': 'H', 'ň': 'W',
8     ...
9     # Myanmar-specific consonants
10    'n': 'n', # Myanmar final nasal
11    'r': 'r', # Alternative rhotic
12    't̪': 't̪', 'd̪': 'd̪', # Retroflex
13    'ʈ': 'r̪', # Retroflex flap
14    'ɸ': 'f', 'β': 'v', # Bilabial fricatives
15    'ʂ': 'S', 'ʐ': 'Z', # Retroflex fricatives
16    'χ': '?', 'ħ': 'h', # Pharyngeal
17    'θ': 'p', 't̪': 't̪', 't̪': '!', 't̪': 'c̪', 't̪': 'l̪', # Clicks
18    ...
19    # Vowels
20    'i': 'i', 'ɪ': 'I', 'e': 'e', 'æ': 'E', 'ə': '&',
21    'a': 'a', 'ɑ': 'A', 'ɔ': 'O', 'ɒ': 'o', 'ʊ': 'U', 'u': 'u',
22    'ʌ': 'V', 'ə': '@', 'ə': '@', 'ə': '3', 'ə': '3',
23    ...
```

- IPA2espeak
- Run လုပ်လိုက်
- Wav ဖုံး
- ထုတ်လိုက်
- နားထောင် လိုက်
- Mapping ကုပ်ပြင်လိုက်

Introduction to Phonetics (Example Demo Application)

```
24     ... # Myanmar-specific vowels
25     ... 'ှ': 'M', 'ှံ': '7', 'ှ့': '1', 'ှး': '2',
26     ...
27     ... # Tone markers (Myanmar uses these as diacritics)
28     ... 'ဲ': '_L', ... # Low tone
29     ... 'ေ': '_H', ... # High tone
30     ... 'ံ': '_R', ... # Rising tone
31     ... 'ဴ': '_F', ... # Falling tone
32     ... 'ဵ': '_M', ... # Mid tone
33     ... '္': '_HH', ... # Extra high
34     ... '်': '_LL', ... # Extra low
35     ...
36     ... # Diacritics
37     ... 'ာ': '_h', ... # Aspirated
38     ... 'ိ': '_j', ... # Palatalized
39     ... 'ု': '_w', ... # Labialized
40     ... 'ုံ': '_G', ... # Velarized
41     ... 'ူ': '?', ... # Pharyngealized
42     ... 'ီ': '~, ... # Nasalized
43     ... 'ုး': '0', ... # Voiceless
44     ... 'ုံး': 't', ... # Breathy voice
45     ... 'ုံုး': 'd', ... # Dental
```

- တကယ်တမ်း
ခေါင်းစားတာက
myG2P မှာ
ထပ်ဖြည့်ထားတဲ့
အပိုင်းတွေကို
mapping
လုပ်ရတဲ့အပိုင်းပါ

Introduction to Phonetics (Example Demo Application)

```
ye@1st-hpc3090:~/exp/vs/ipa2speech$ python ./ipa_my2speech.py --help
usage: ipa_my2speech.py [-h] [--input INPUT] [--output OUTPUT] [--voice VOICE] [--speed SPEED]
```

Convert IPA (International Phonetic Alphabet) to speech using espeak

options:

- h, --help show this help message and exit
- input INPUT Input file containing IPA text (one per line) (default: None)
- output OUTPUT Output WAV file (if not specified, returns audio data) (default: None)
- voice VOICE Voice to use for speech synthesis (default: en-us)
- speed SPEED Speech speed in words per minute (default: 120)

```
ye@1st-hpc3090:~/exp/vs/ipa2speech$ ■
```

Introduction to Phonetics (Example Demo Application)

```
ye@lst-hpc3090:~/exp/vs/ipa2speech$ cat ./test1.ipa.txt  
kə tʃɪ `n  
kə já  
kə ji `n  
tʃɪ `n  
mə `n  
bə mə  
jə kʰà i `n  
ʃá `n  
ye@lst-hpc3090:~/exp/vs/ipa2speech$ -
```

- ဆရာ ဘာတွေ
ရိုက်ထည့်ထားတာ
လဲ ဖတ်နင်တဲ့သက
ဖတ်ပေးကြပါ။

Introduction to Phonetics (Example Demo Application)

- ရှေ့က IPA input ဖိုင်ကနေ wave ဖိုင် (i.e. အသံဖိုင်) အဖြစ် ပြောင်းပြမယ်

```
ye@lst-hpc3090:~/exp/vs/ipa2speech$ time python ipa2speech.py --input ./test1.ipa.txt --output ./8_ethnicics.wav
Using espeak version: eSpeak NG text-to-speech: 1.52.0 Data at: /usr/local/share/espeak-ng-data
Processing IPA text: kə təʃi `n kə já kə ji `n təʃi `n mɔ̃ n bə mà jə khà iN sá N
Converted IPA to eSpeak: kə təʃi `n kə já kə ji `n təʃi `n mɔ̃ n bə mà jə khà iN sá N -> k@ ts_hI_Ln k@ ja_H k@ jI_Ln ts_hI_Hn m
U_Ln b@ ma_L j@ k_ha_LIn Sa_Hn
Successfully generated speech and saved to ./8_ethnicics.wav

real    0m0.096s
user    0m1.478s
sys     0m0.023s
```

```
ye@lst-hpc3090:~/exp/vs/ipa2speech$ soxi ./8_ethnicics.wav
Input File      : './8_ethnicics.wav'
Channels        : 1
Sample Rate     : 22050
Precision       : 16-bit
Duration        : 00:00:04.91 = 108191 samples ~ 367.997 CDDA sectors
File Size       : 216k
Bit Rate        : 353k
Sample Encoding: 16-bit Signed Integer PCM
```

```
ye@lst-hpc3090:~/exp/vs/ipa2speech$
```

- Soxi command နဲ့
wavefile information
ကို ကြည့်လို ရတယ်။

Introduction to Phonetics (Example Demo Application)

- Conversion လုပ်ပြီး ရလာတဲ့ wavefile ကို နားထောင်ကြည့်ကြရအောင်
- 8_ethnics.wav



Introduction to Phonetics (Burmese)

လေလိုင်းသွှေဖော်နှင့်
မြန်မာ့သွှေပိုဝါမိန္ဒာမောဇ

(လေလိုင်းသွှေဖော်နှင့် မြန်မာစကားသဲ ပြောင်းလဲမှနစ်)

ဘွဲ့ဂျွန်ဘာသာဇာ ကျမ်းပြောများနှင့် သုတေသနများ၏
ဘာသာစကား၊ လေလာတော်ပြုအတွက် သိပ္ပါနီယာသောတရားများနှင့်
လက်တွေ့ကျွန်ုတ်များ

**Acoustic Phonetics
and
The Phonology
of the Myanmar Language**

(Theories and practices for practical language analysis)

ဒေါက်တာသိန်းထွန်း

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- တကယ်တမ်း မြန်မာစာနဲ့ ပတ်သက်တဲ့ phonetic, speech တွေကို လုပ်မယ် ဆိုရင် ဖတ်ကို ဖတ်ကြရလိမ့်မယ်
- သံပြင်း/သံညှင်း ပြောင်းတဲ့ ကိစ္စတွေ
- တန္တည်းအားပြင့် G2P ကိစ္စတွေ နဲ့ ပတ်သက်ပြီး အသေးစိတ် study လုပ်ထားတယ်
- စာအုပ် အနေနဲ့ရော၊ PDF ဖိုင်အနေနဲ့ပါ သိမ်းထားတယ်
- လိုအပ်တဲ့အခါမှာ အသုံးဝင်လို့

Introduction to Phonetics (Burmese)

/la^ʔ + pau[?]/ → [la^ʔm[̂] bau[?]]cl N ph
N V

လမ်း ပေါက် → [လမ်းပေါက်] doorway

/hle⁻ + t^{χou}⁻/ → [hle⁻ d^{χou}⁻]cl N ph
N V

လှေ ငှံ → [လှေငှံ] boat that can be
hailed for a free ride

/wū⁻ + t^{χi}[^]/ → [wūn⁻ d^{χi}[^]]cl N ph
N V

ဝန် ငြား → [ဝန်ငြား] (carrier of heavy duty, heavy burden) minister

/əpjō⁻ + t^{χhɔ}[^]/ → [əpjō⁻ d^{χhɔ}[^]]cl N ph
N V

အပို။ ရော် → [အပိုရော်] beautiful maiden

Introduction to Phonetics (Burmese)

(အရေး → အပြော ၁) /e/ → [i]

(အရေးပုံစံနှင့် အနက်ပေးသံရင်း ဖိန်းတို့ထာဝရမကိုက်ညီသည်ကိုသတိပြုပါ)
အရေးပုံစံ

written form -- “**k^hwe k^hje m^hje p^hje**” /e/ → [-i]
 ခြွေ ချေ မြေ ဖြေ /e-/ [-/-/-:]

/k^hwe[^] + k^hje⁻/ → [k^hwe[^] t^hhi⁻] op com N
 N N
 ခြွေ: ခြေ [ခြွေ:ခြေ/ခြို] dog feet, stool

/k^hje⁻ + t^hauk/ → [t^hhi⁻ daw[?]] cl com N
 N N
 ခြေ ထောက် [ခြိုဒေါက်] leg

/k^hje[^]/ → [t^hhi⁻]
 N
 ချေး [ခြို:] excreta

/m^hje[^]/ → [mji[^]]
 N
 မြေး [မြိုး:] grandchild

- မြန်မာစာမှာက
ရေးတဲ့အတိုင်း
မဖတ်တာတွေ အများကြီးပဲ
- ရေးတော့အမှန် ဖတ်တော့
အသံ
- Rule နဲ့လုပ်ကြည့်ခဲ့တယ်
- Exceptional rule တွေ
အများကြီးပါပဲ
- ဆရာ G2P paper မှာ
ဖော်ပြထားပါတယ်

Introduction to Phonetics (Phonetic vs Phonology)

Phonetic

- Studies the physical aspects of speech sounds: how they're produced (articulation), transmitted (acoustics), and perceived (hearing).
- Focuses on **all possible sounds** humans can make, regardless of language.
- Example: Analyzing how the tongue moves for the "t" sound in "tea" vs. "tree."

Introduction to Phonetics (Phonetic vs Phonology)

Phonology

- Studies how sounds **function systematically** in a particular language.
- Focuses on **meaningful sound patterns** (e.g., why "pat" and "bat" are distinct words in English).
- Example: The rule that English plural "-s" sounds like /s/ (cats) or /z/ (dogs).
- **TL;DR:** Phonetics = raw sounds; Phonology = sound rules in a language.

Praat

[fon.hum.uva.nl/praat/](https://www.fon.hum.uva.nl/praat/)

Praat: doing phonetics by computer

Download Praat:

- * [Macintosh](#), [Windows](#)
- * [Linux](#), [Raspberry Pi](#), [Chromebook](#)
- * [\(FreeBSD, SGI, Solaris, HPUX\)](#)
- * [license](#) and [source code](#)



[Paul](#)

Information on Praat:

- * Introductory tutorial: choose **Intro** from Praat's **Help** menus.
- * Extensive manuals and tutorials: in Praat's **Help** menus.
- * [Beginner's manuals by others](#).
- * Paul Boersma's [publications](#) on algorithms and tutorials.



[David](#)

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The Netherlands

Questions, problems, solutions:

1. Many problems can be solved by upgrading to [version 6.4.39](#) of Praat.
2. Make sure you have read the [Intro](#) from Praat's **Help** menu.
3. If that does not help, use the **Search** button in Praat's manual window.
4. Or consult the [Frequently Asked Questions](#) directly.
5. There is a user group on the Internet: the [Praat User List](#).
6. If none of the above helps, you can send email to paul.boersma@uva.nl.

Praat Homepage: <https://www.fon.hum.uva.nl/praat/>

38

Praat (Useful Shortcuts)

Windows	Mac	Function
Tab	Tab	Play from cursor/selected portion
Ctrl+I	Command+I	Zoom in
Ctrl+O	Command+O	Zoom out
Ctrl+N	Command+N	Zoom to selected portion
Ctrl+A	Command+A	Show all (zoom full range)
Ctrl+B	Command+B	Zoom back (previous zoom level)
Enter	Return	Add boundary at cursor
Alt+Backspace	Option+Delete	Delete selected boundary
Ctrl+R	Command+R	Run a script
Ctrl+T	Command+T	Run selected portion of a script

- Praat ကို စသုံးစမှာ ခက်လိမ့်မယ်
- Shortcut key တွေကို သိထားပုံ အလုပ်လပ်ရတာ အဆင်ပြေလိမ့်မယ်

Preparing Myanmar Language Vowels

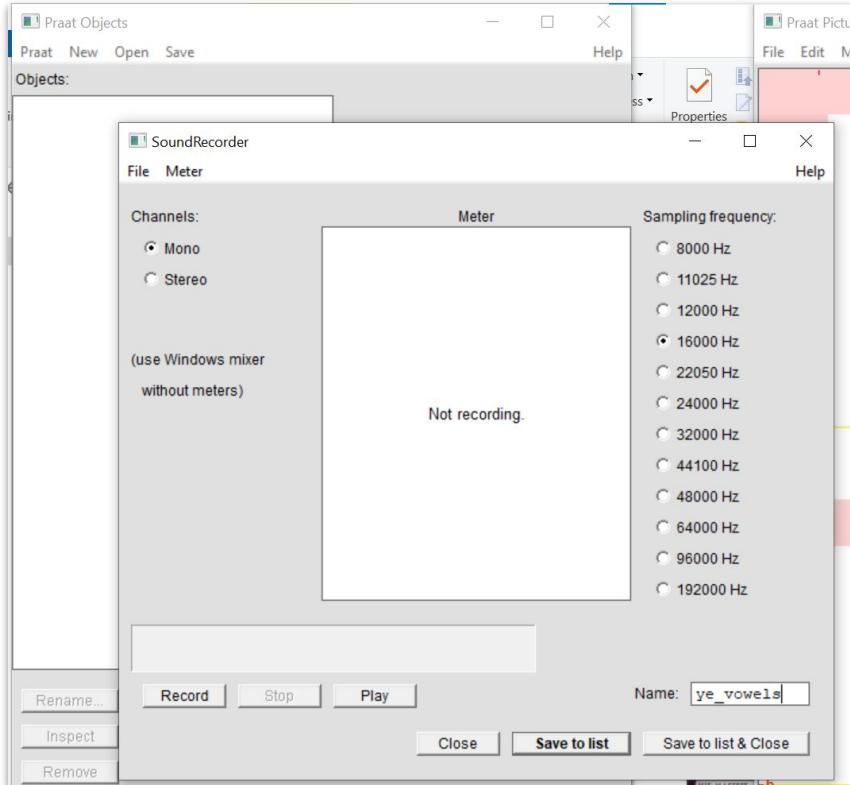
- အ၊ အာ၊ အိ၊ အီ၊ အု၊ အူ၊ အေ၊ အဲ၊ အော
- လွှဲလာမိသလောက်၊ တကယ်တမ်းက (အ၊ အာ၊ အိ၊ အု၊ အေ၊ အဲ၊ အော) နှင့်
လုံလောက်ပါတယ်
- Coding လုပ်ဖို့အတွက်က Unicode နံပါတ်တွေပါ သိထားသင့်တယ်
- a (\u0061), အ (\u0069), i (\u0069), ဗ (\u0075), e (\u0065), ε (\u025B), ဥ (\u0075)

Preparing Myanmar Language Vowels

Myanmar Vowel	IPA	Explanation
အာ	/a/	Central low vowel
အာ	/a/	Low back vowel
အိ / ဒီ	/i/	High front vowel
အူ (ဥ) / အူ (္မြ)	/u/	High back vowel
အေ / ဧ	/e/	Mid front vowel
အဲ	/ɛ/	Open-mid front vowel
အော / ဉာ	/o/	Close-mid back vowel

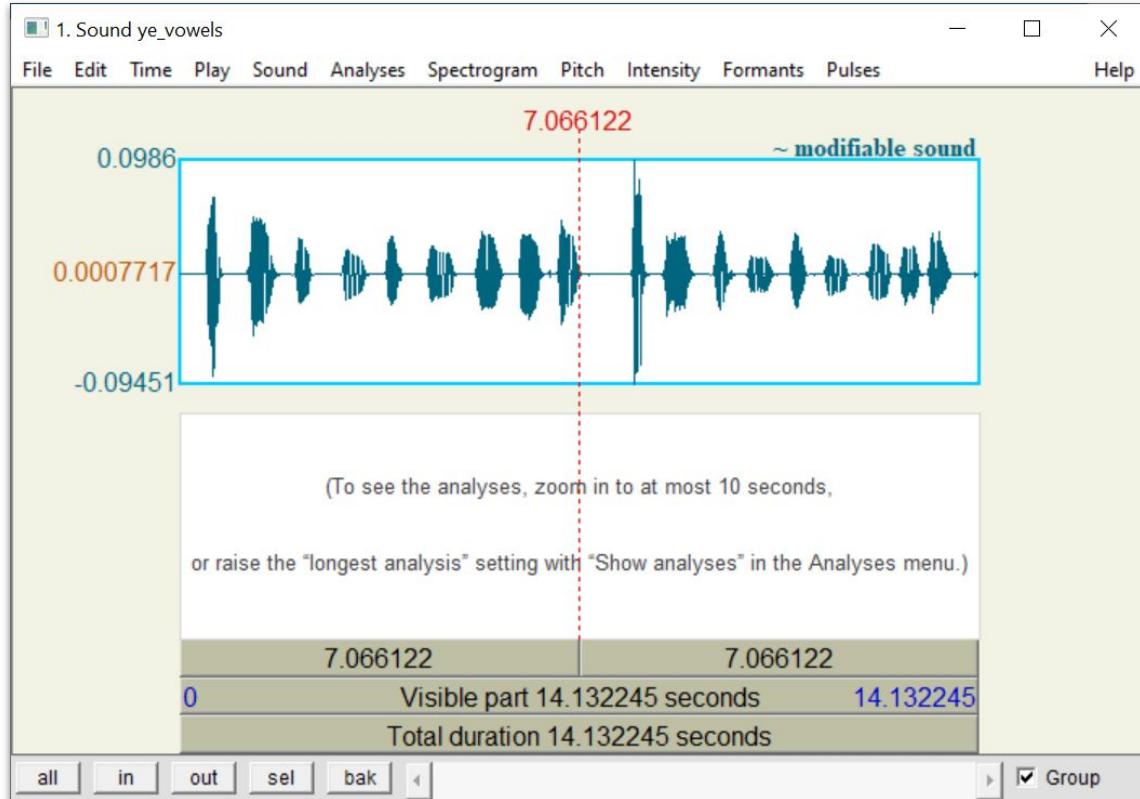
- အားလုံး ညီအောင်ညိုပြီး recording လုပ်ကြပါ
- လက်ရှိအတိုင်း အ၊ အာ၊ အိ၊ အူ၊ အေ၊ အဲ၊ အော ဆိုပြီး အသံသွင်းလည်း အဆင်ပြုပါတယ်
- သိမဟုတ အ၊ အာ၊ အိ၊ အဲ၊ အူ၊ အေ၊ အဲ၊ အော၊ အော်၊ အံ၊ အား ဆိုပြီး အသံသွင်းကြမယ် ဆိုရင်လည်း အားလုံးညိုပြီး လုပ်ကြပါ

Recording



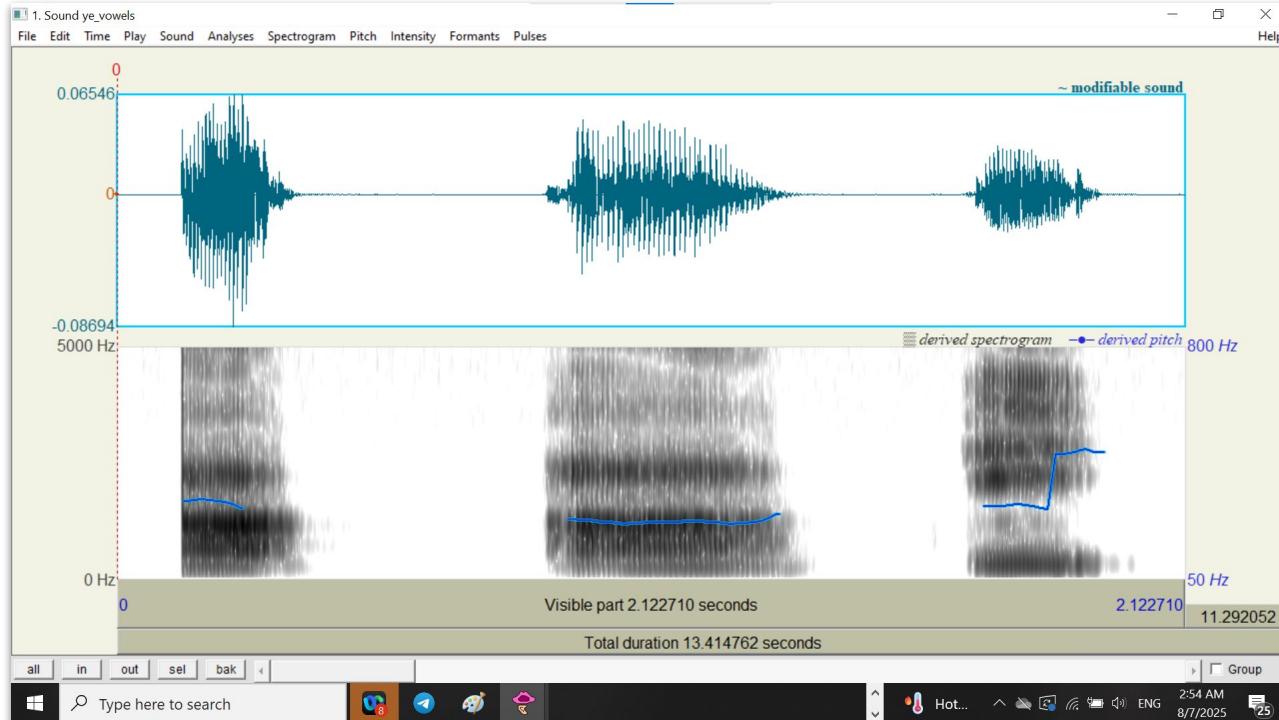
- အဆင်ပြတဲ့ recorder နဲ့ recording လုပ်လို့ ရတယ်
- Praat ကို သုံးပြီး လုပ်တာက ပိုကောင်းတယ်
- Noise မများတဲ့ နေရာမှာ အသံသွင်းပါ

Formant Tracking



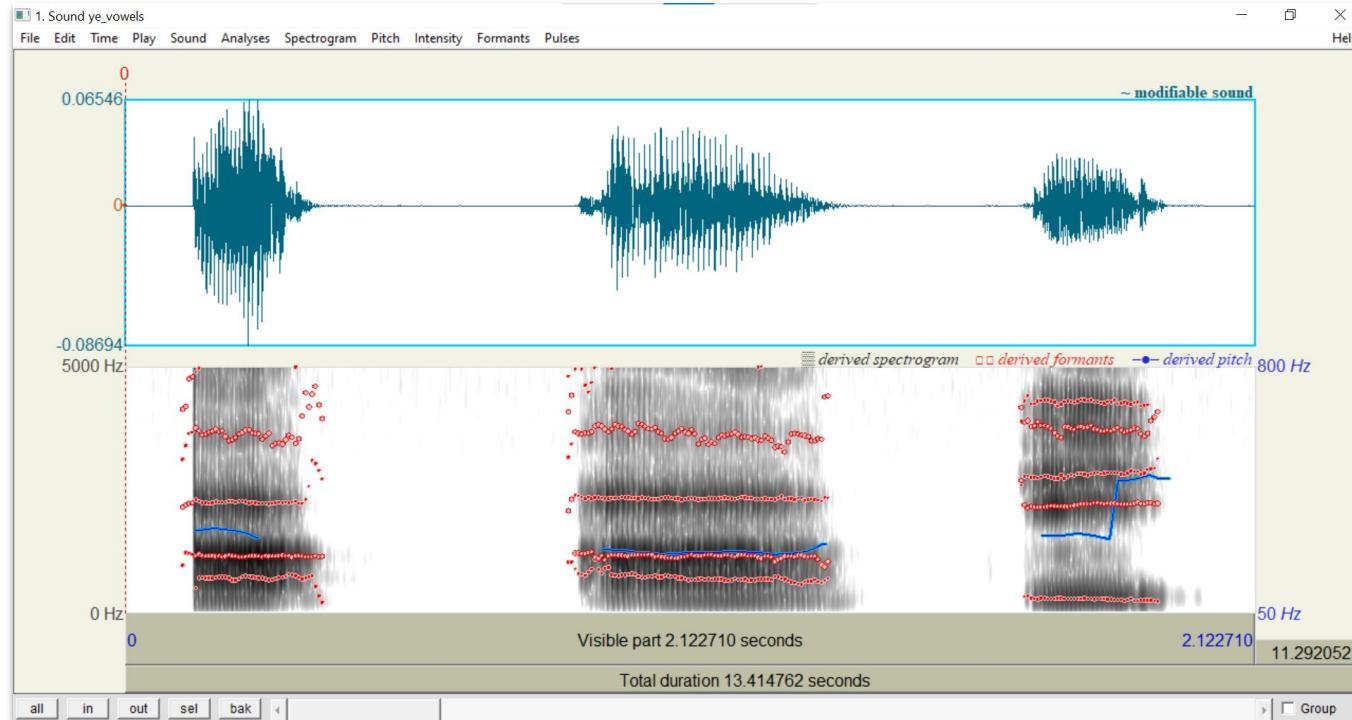
- အေ၊ အာ၊ အိ၊ အီ၊
အု၊ အူ၊ ဧ၊ အဲ၊
ဧ၊
- နှစ်ခါ
အသံသွင်းခဲ့တယ်

Formant Tracking



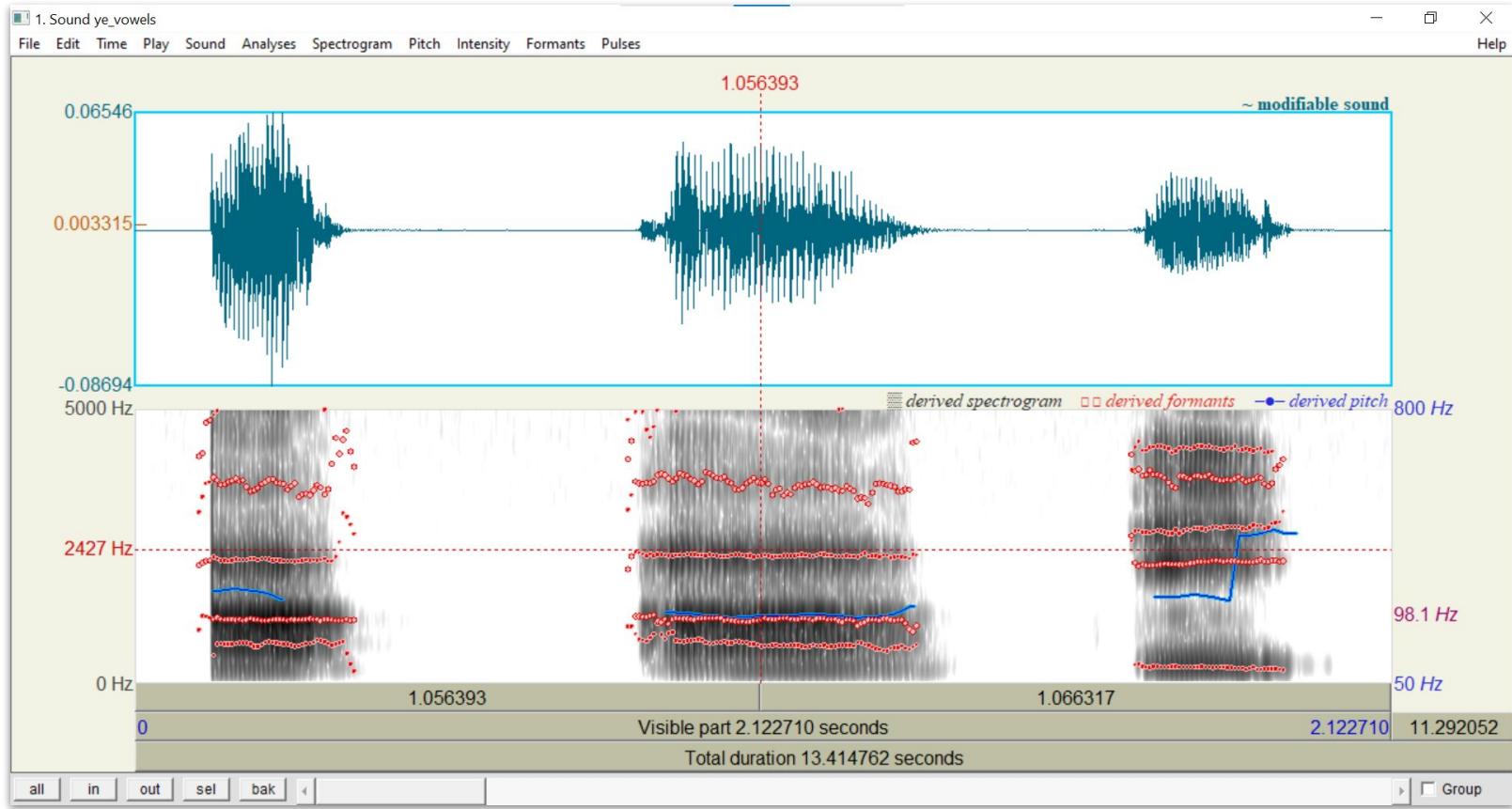
- Selection ମୁର୍ତ୍ତିକାଃତେ ଆପିନ୍ଦିନ୍ଦିଗ୍ନି କେ Ctrl+N ଫେଲ୍ କରି Zoom in କରିବାକୁ ପାଇଁ Vowel sound ଟେକ୍ କରି ଲେବାପି

Formant Tracking

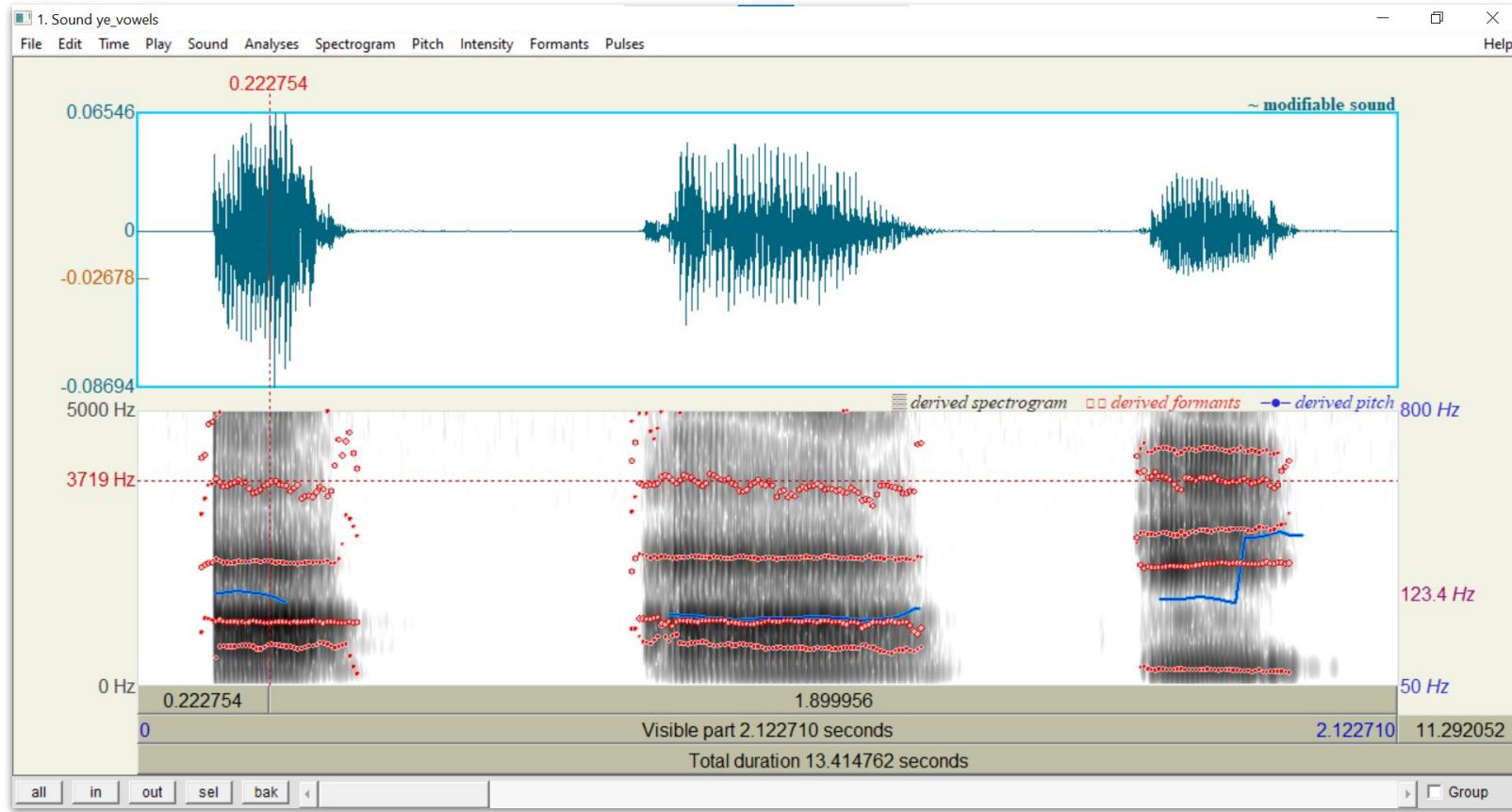


- Formants menu အောက်က Show formants ကို နိုပ်လိုက်ရင် formant line တွေကို အနီရောင်နဲ့ ပြပေးမယ်

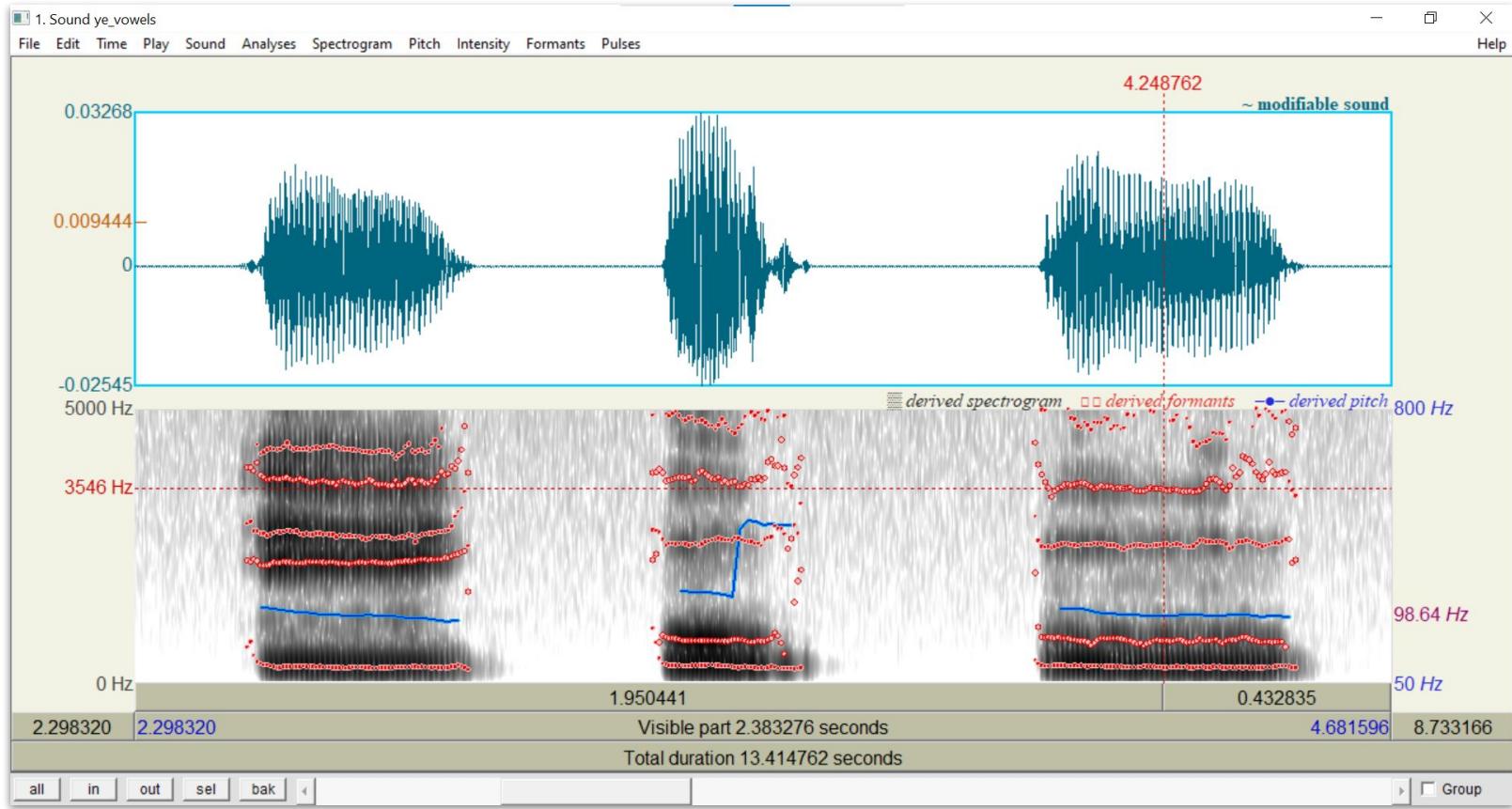
Formant Tracking



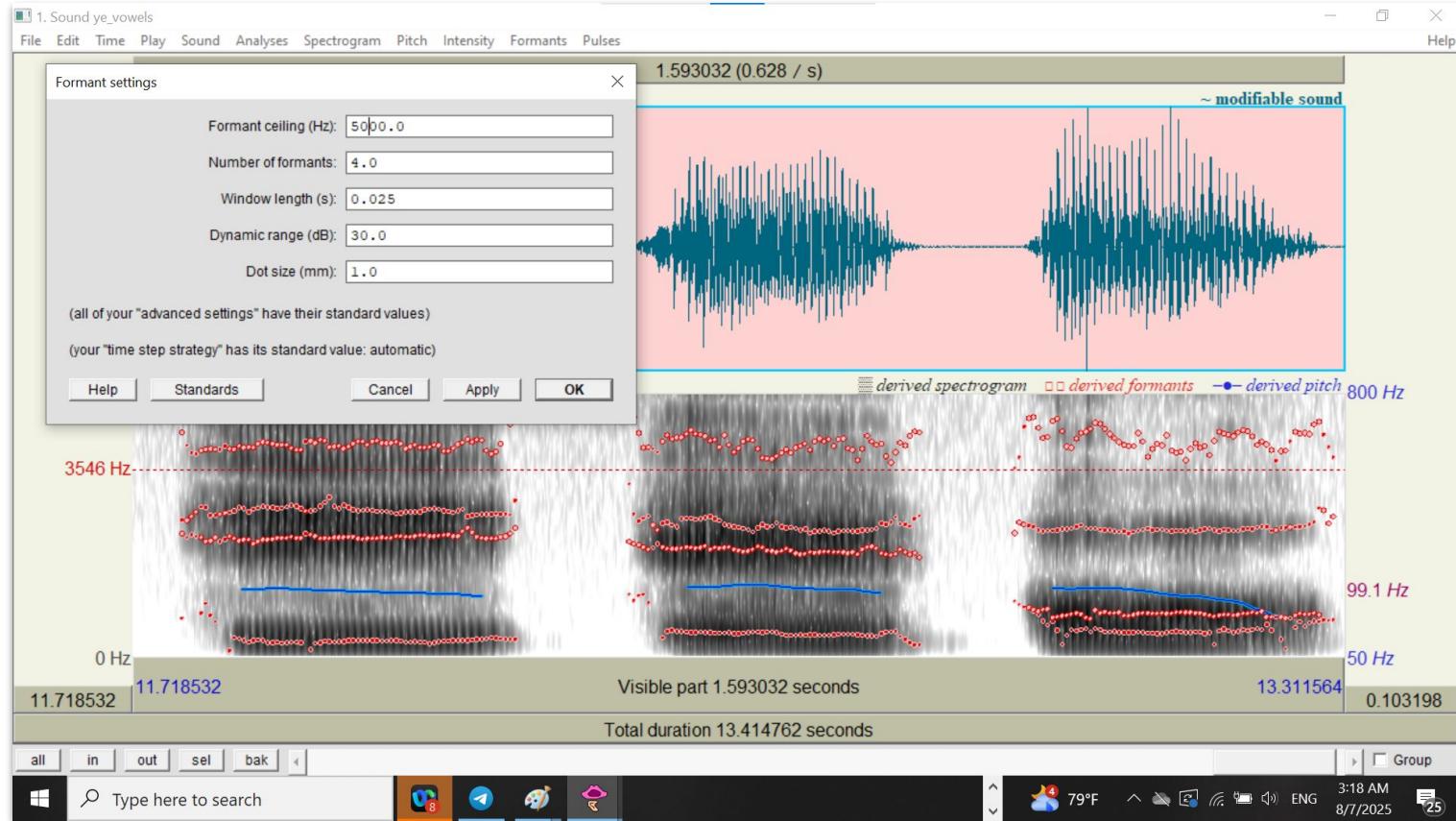
Formant Tracking



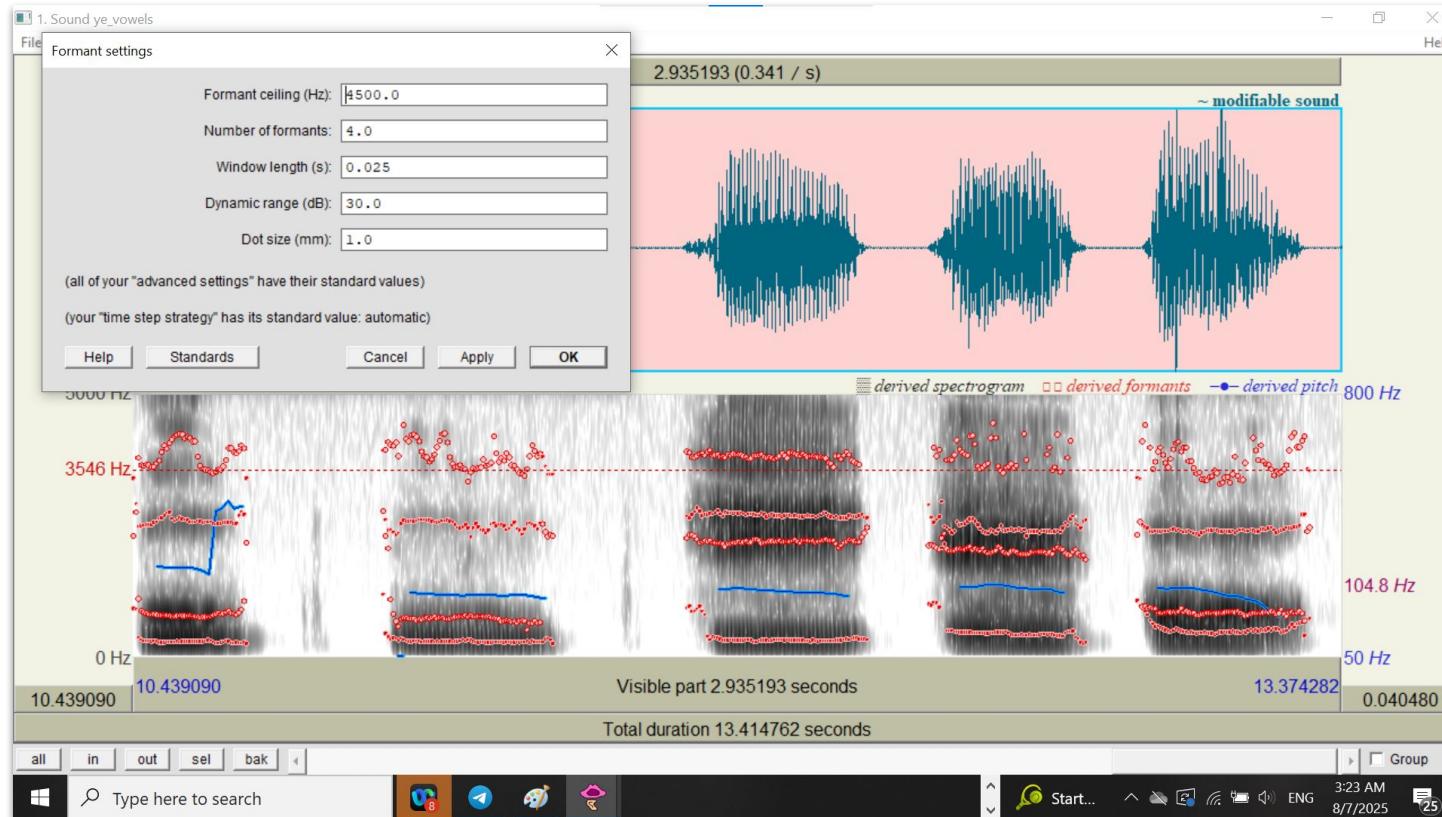
Formant Tracking (Check OK?!)



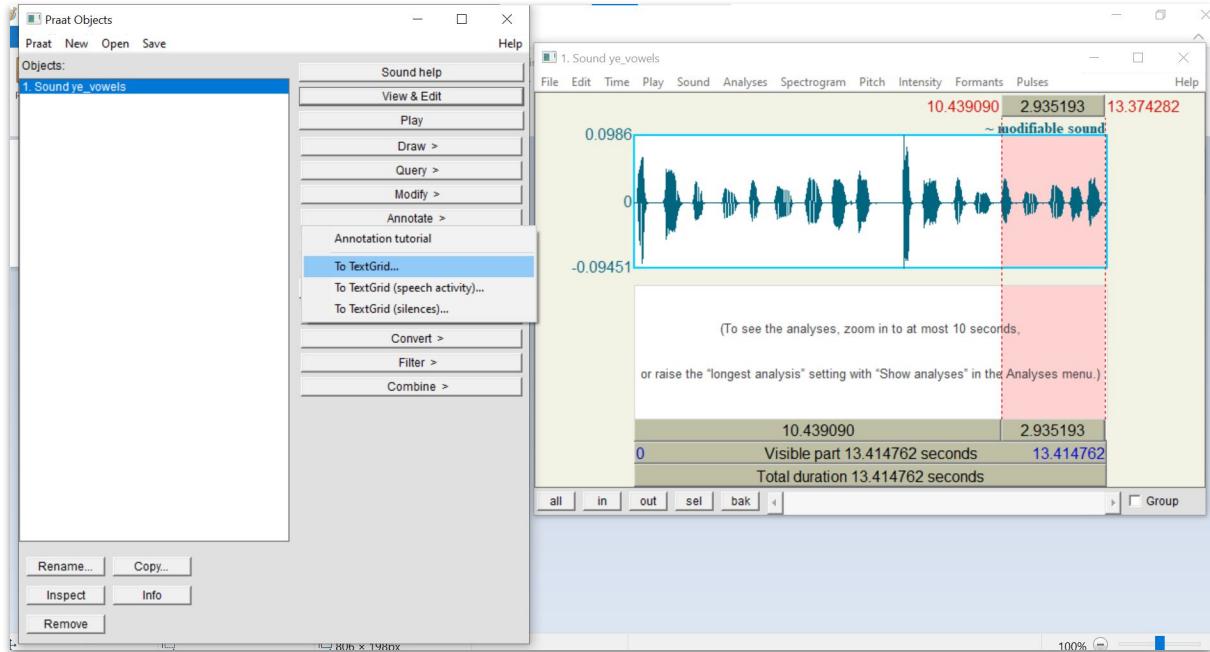
Formant Tracking (setup, 5500 for female, 5000 for male)



Formant Tracking (You have to adjust formant settings)

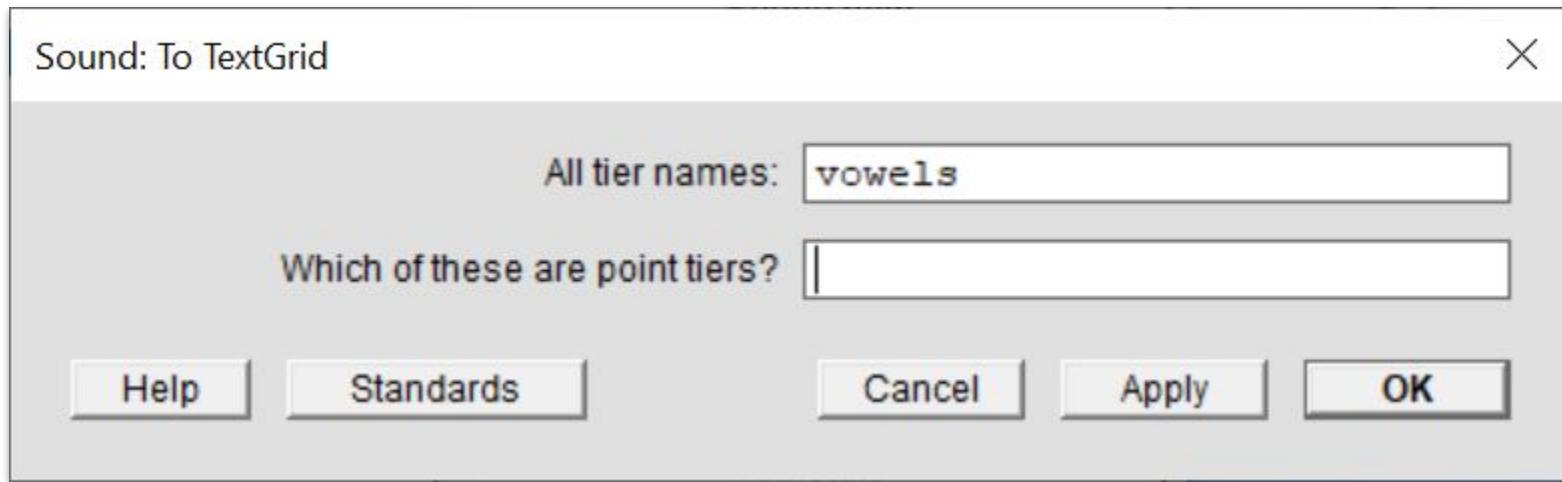


Annotation



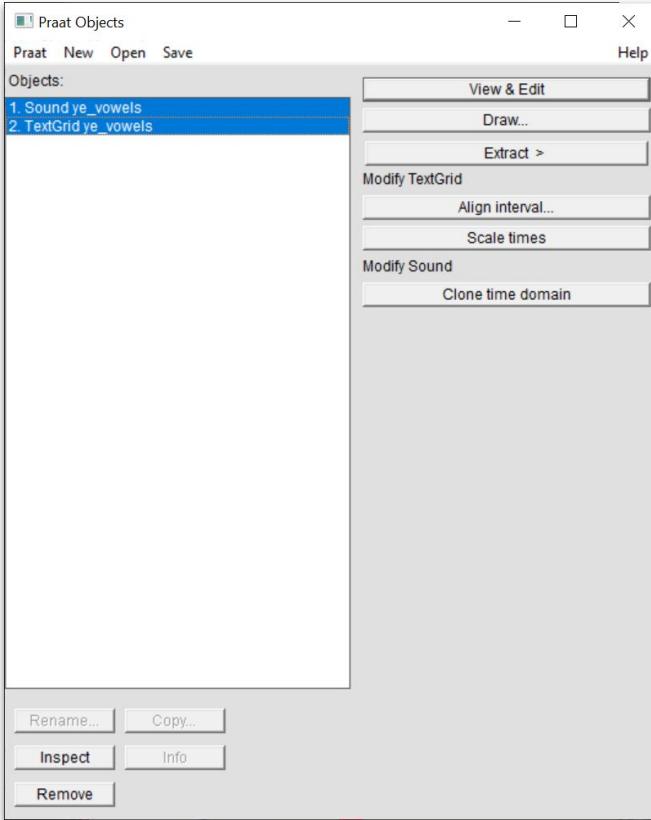
- ට්‍රීෆෙඩාමා annotation ස්ථිතාග අවස්ථුදීයාත් ආ ඇඟ ඇ තානෝගී තත්ත්වයාග්‍රී හෝ ගායෝ තාන් ලැබෙයාත් න්‍යායා පි

Annotation (Single tier is OK)



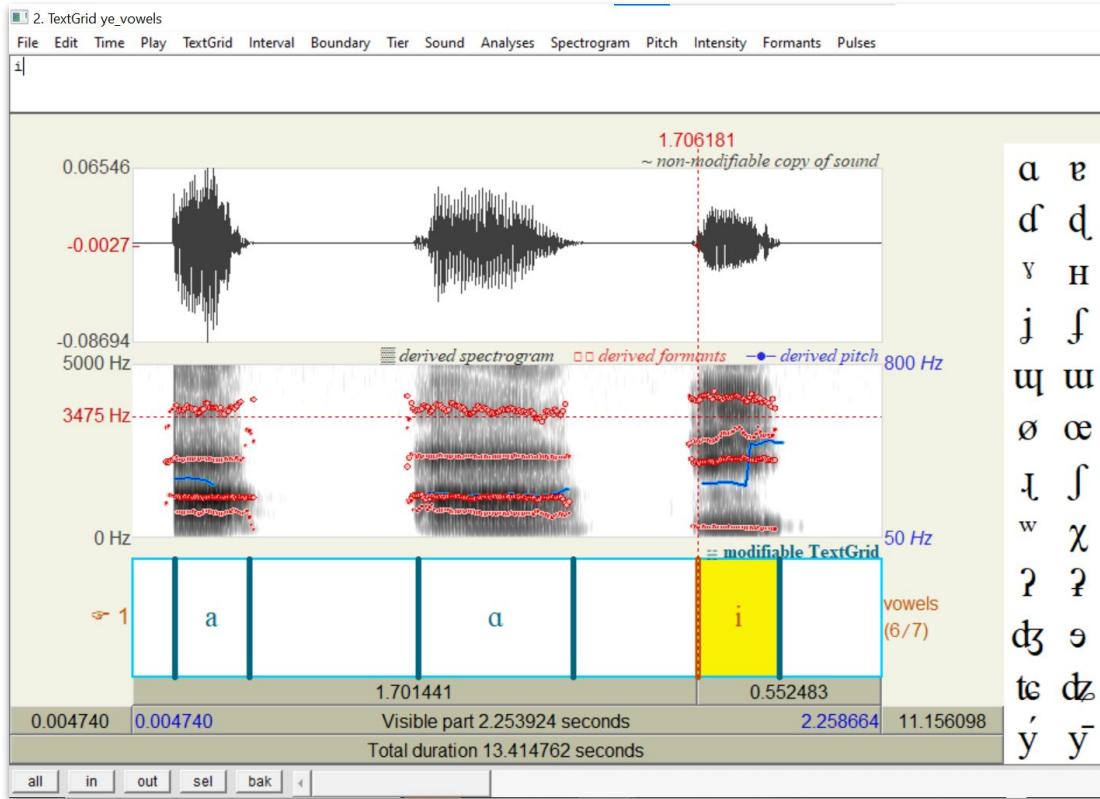
- Tier က တစ်ခုပဲ ထားပါ။ vowels ဆိုပြီး နာမည်ပေးပြီးတော့။
- Which of these are point tiers? ဆူတဲ့ textbox ကိုတော့ blank လုပ်ပါ။

Annotation



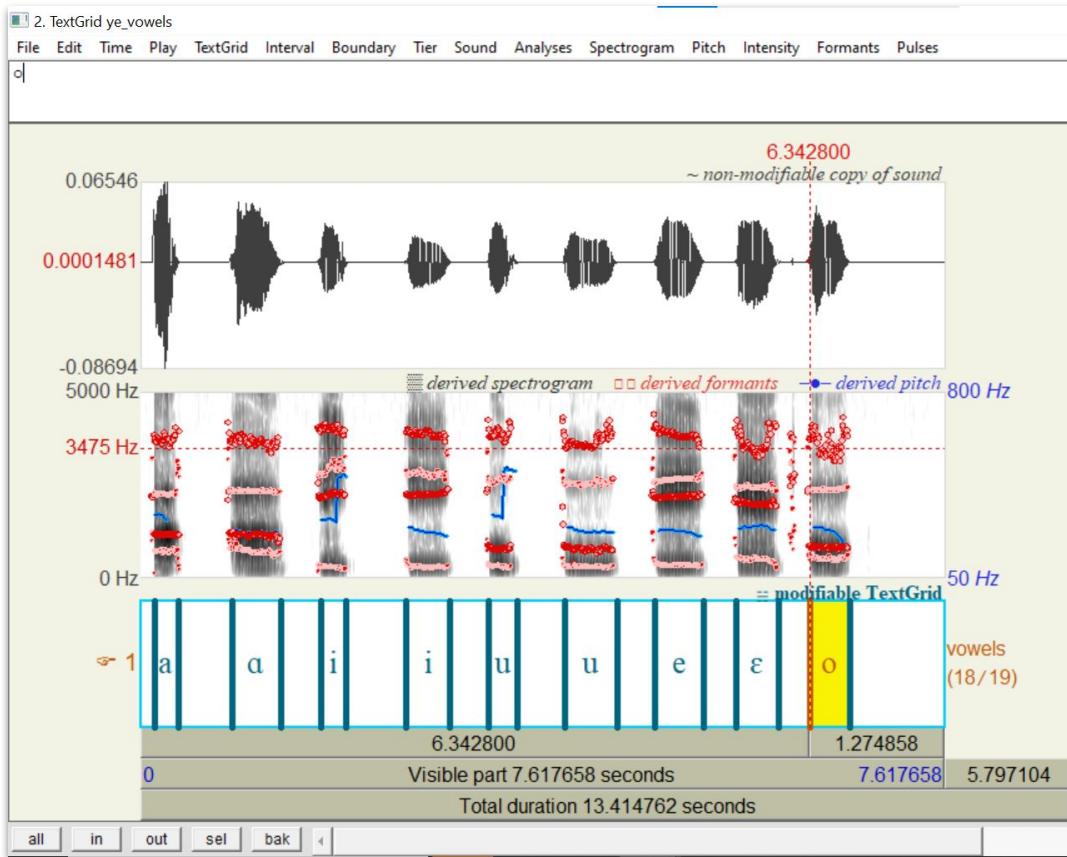
- Sound ကျော် textGrid ကျော် နစ်မျိုးစလုံးကို selection မှတ်ပါ
- ပြီးမှ Annotation လုပ်ပါ

Annotation



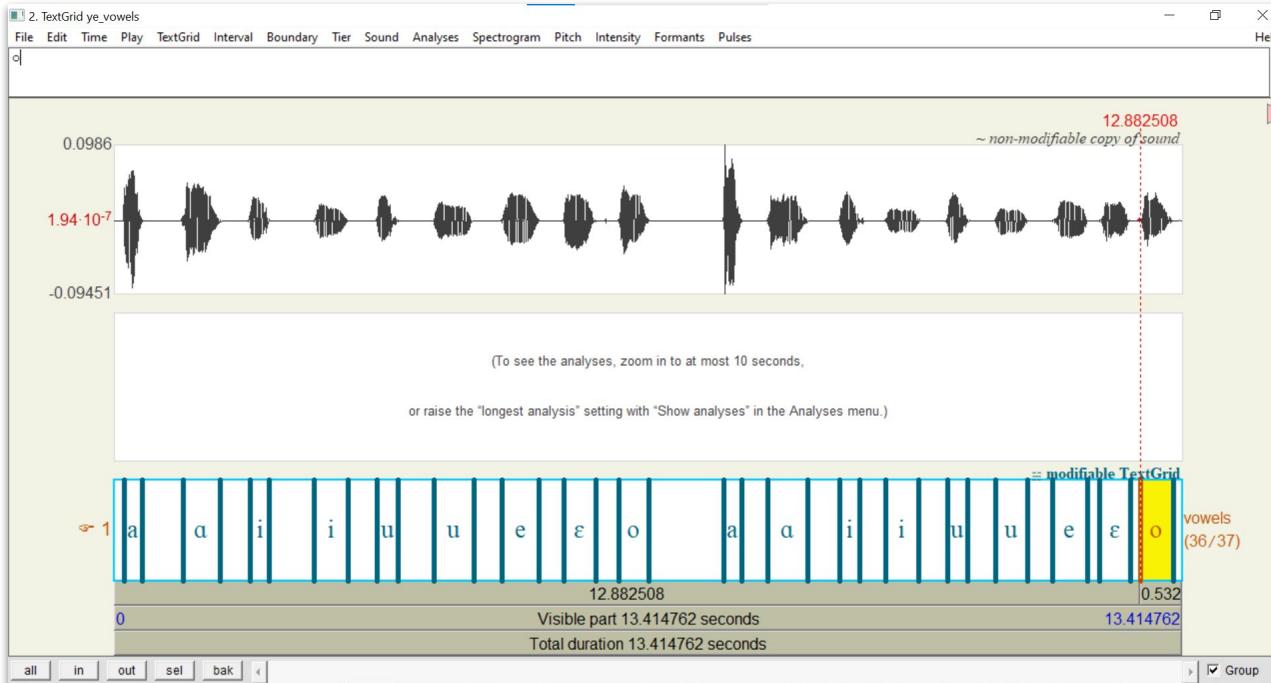
- IPA နဲ့
မထိုးနှင်ရင်လည်း
Roma character
နဲ့ထိုးလည်း
ရပါတယ်

Annotation



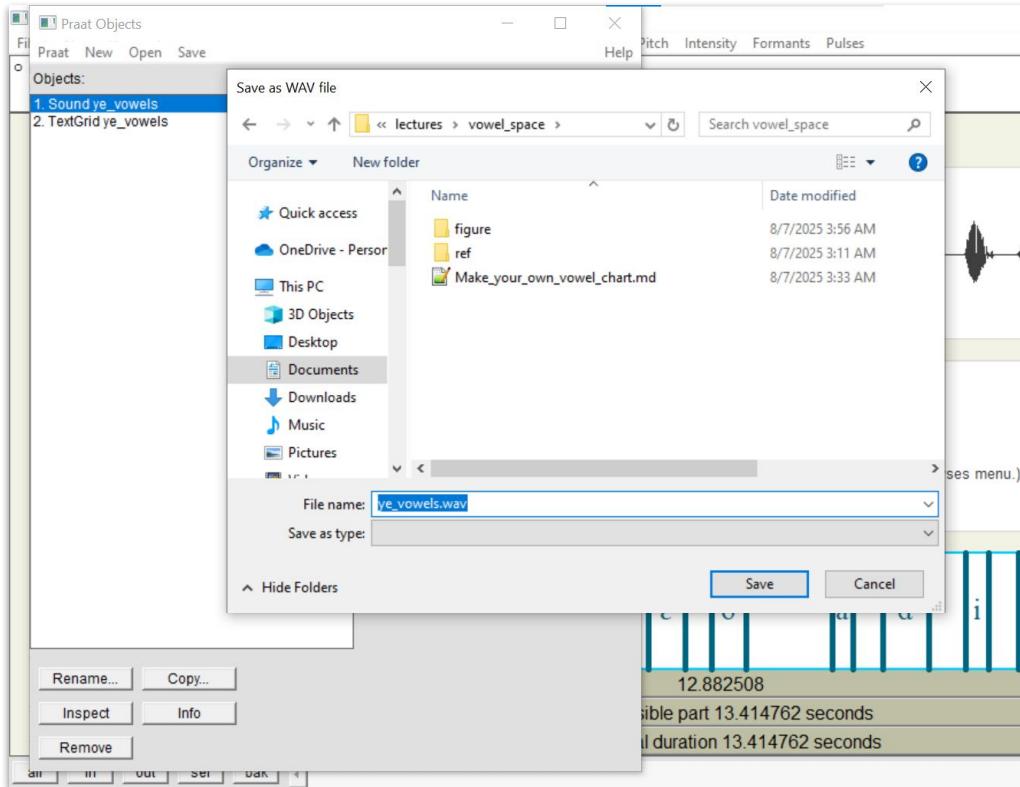
- Annotation
လုပ်ထားတာတွေ
ကို ပြန်စစ်ပါ
- Formant
တွေကိုလည်း
ပြန်စစ်ပါ

Annotation



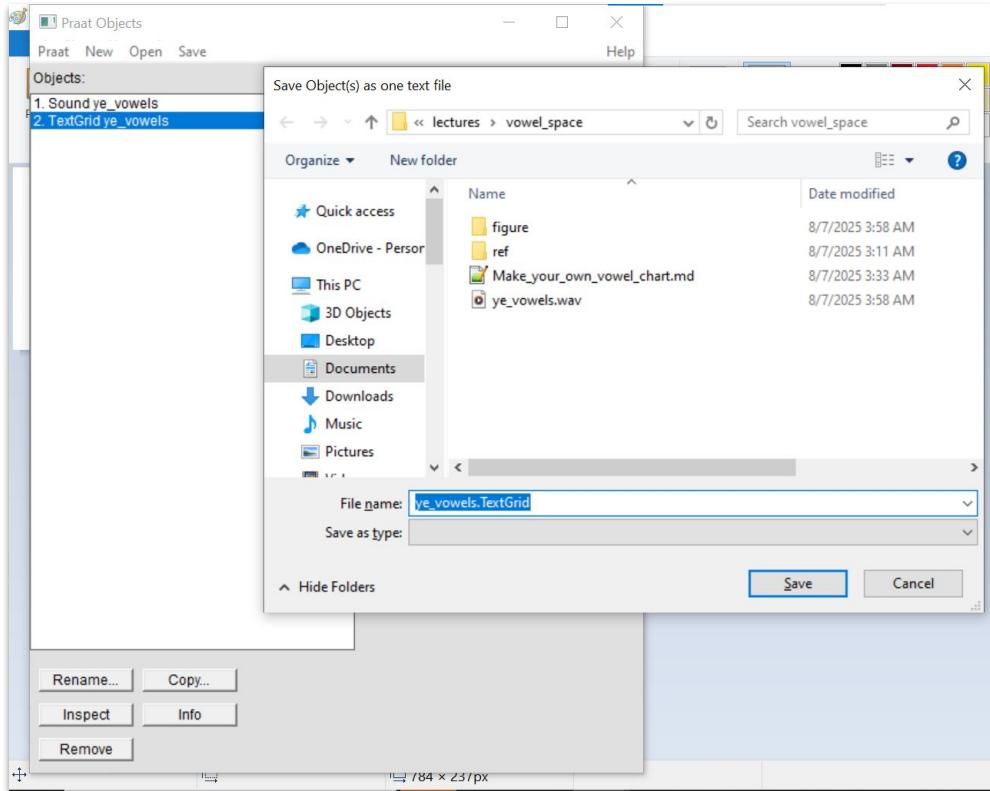
- Vowel အသံအားလုံးကို segmentation လုပ်ပြီး annotation လုပ်ပြီးပြလား စစ်ပါ

Annotation



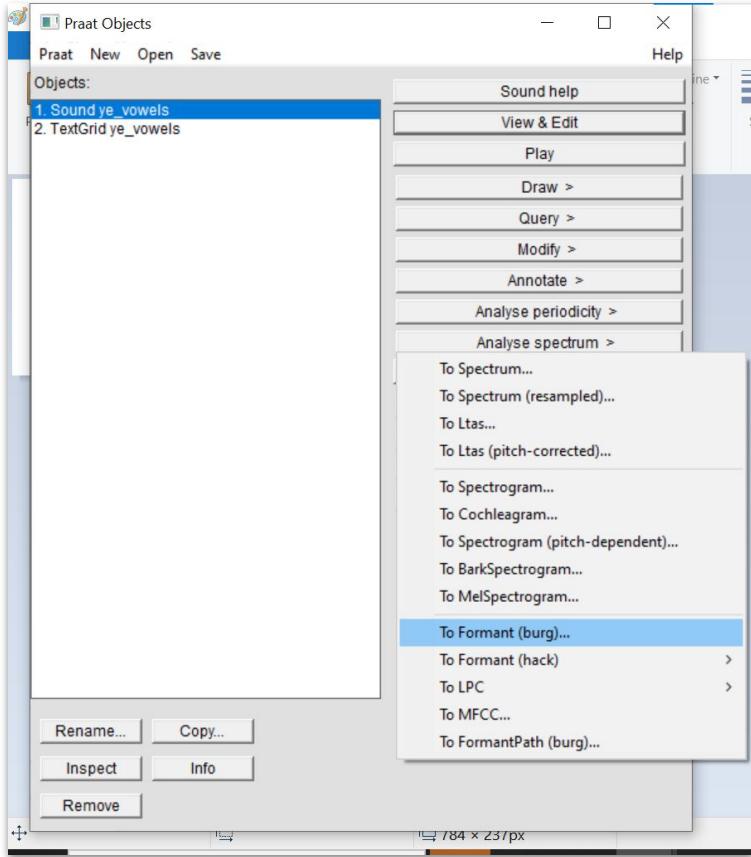
- Wavefile saving

Annotation



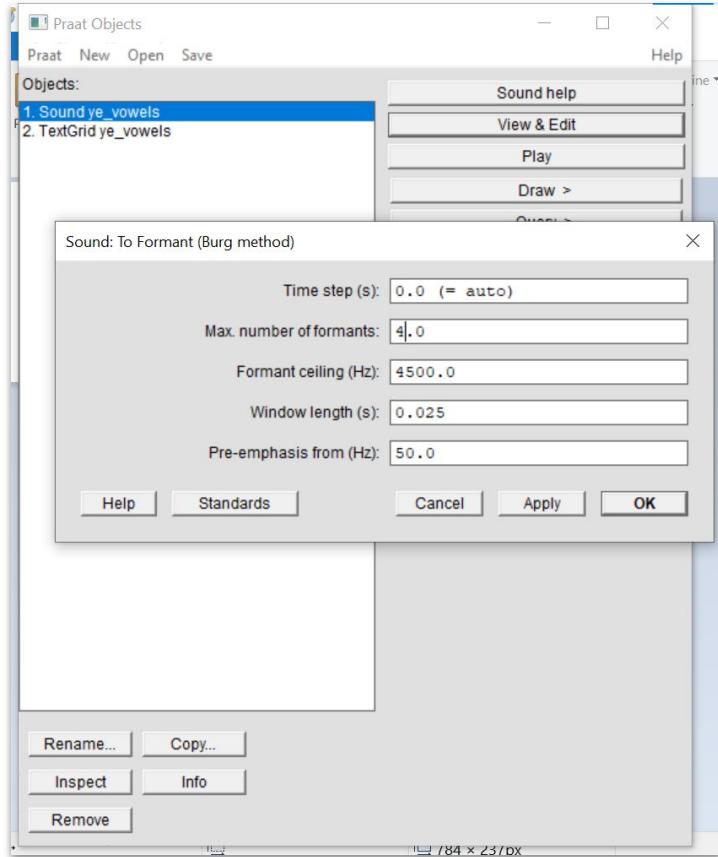
- textGrid file saving

Annotated Spectrum to F1, F2, F3



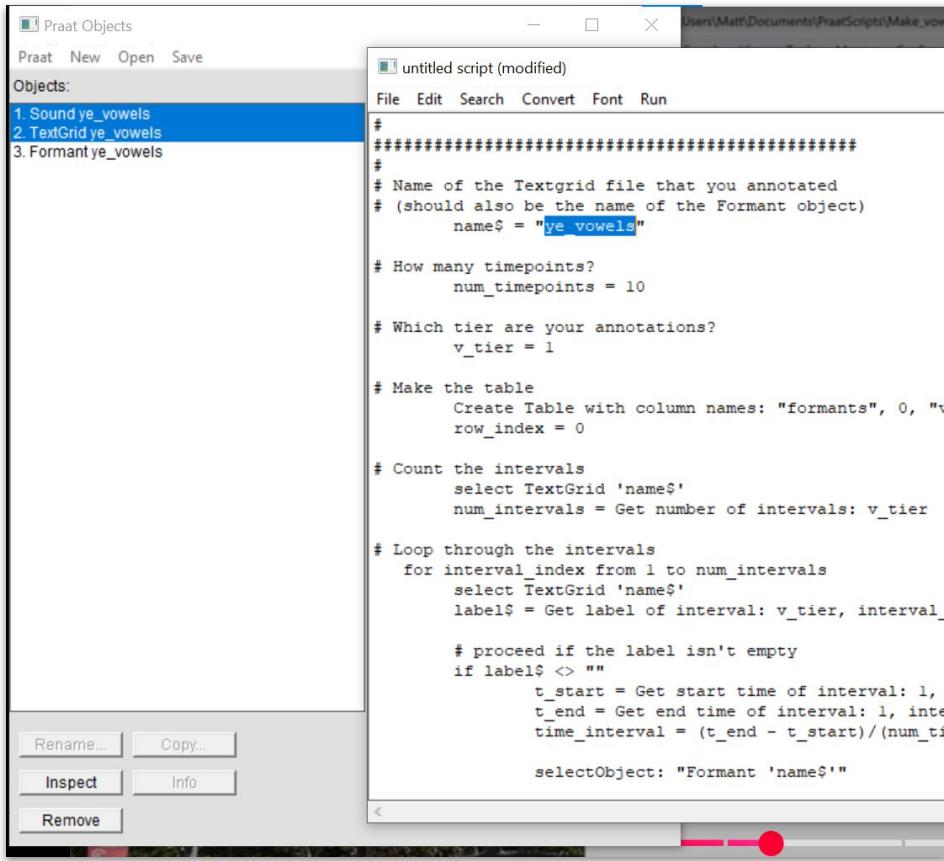
- To Formant (Burg)
- The Burg algorithm is a method used in speech analysis, particularly within software like Praat, to estimate formant frequencies from a sound signal.

Annotated Spectrum to F1, F2, F3



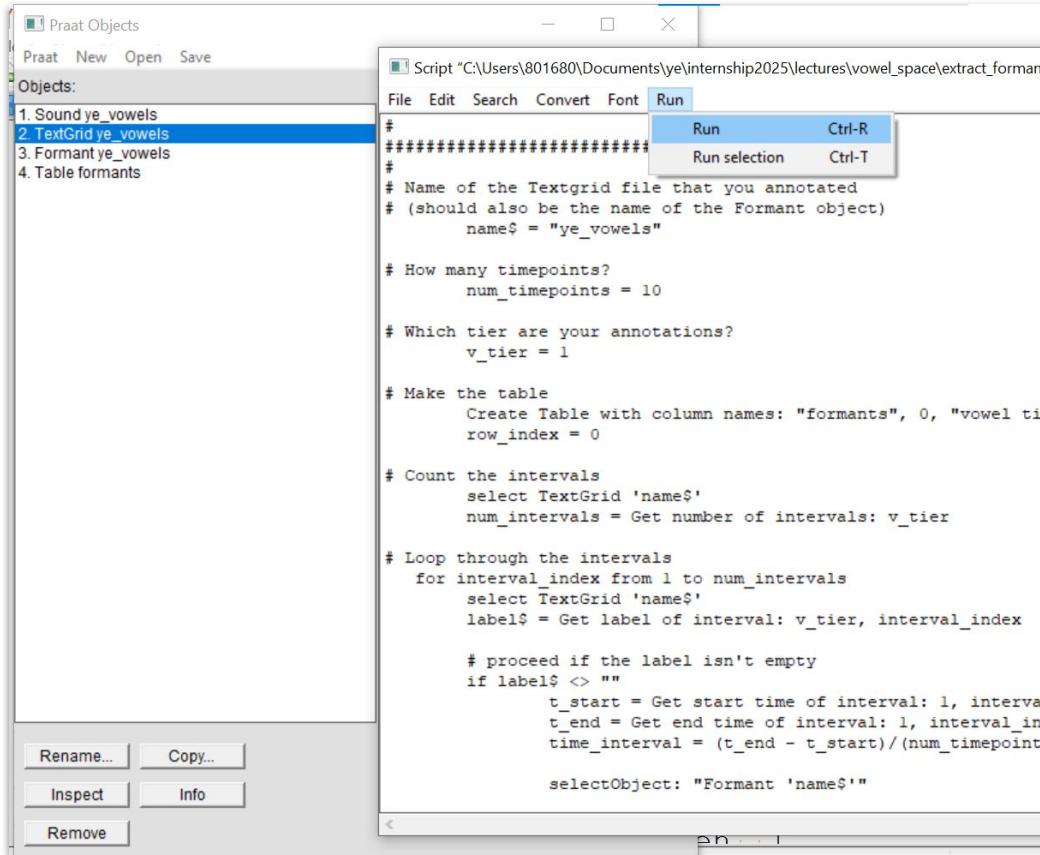
- Annotation လုပ်တိန်းက
ထားခဲ့တဲ့ setting နဲ့ တူတူ
ထားရမယ်

Annotated Spectrum to F1, F2, F3



- Praat Script የፌት ደንብ፡
run በይ
- <https://www.eleanorchodroff.com/tutorial/PraatScripting.pdf>

Annotated Spectrum to F1, F2, F3



- Selection ලුද්‍යායාත් අප්පින්දා ගෝජ් ප්‍රීඩ් රුන් බැංක් තාලන් ලුද්‍යා ගැතයි

Annotated Spectrum to F1, F2, F3

- ඊ variable name
තැනෙක්ද තාබුණය

Annotated Spectrum to F1, F2, F3

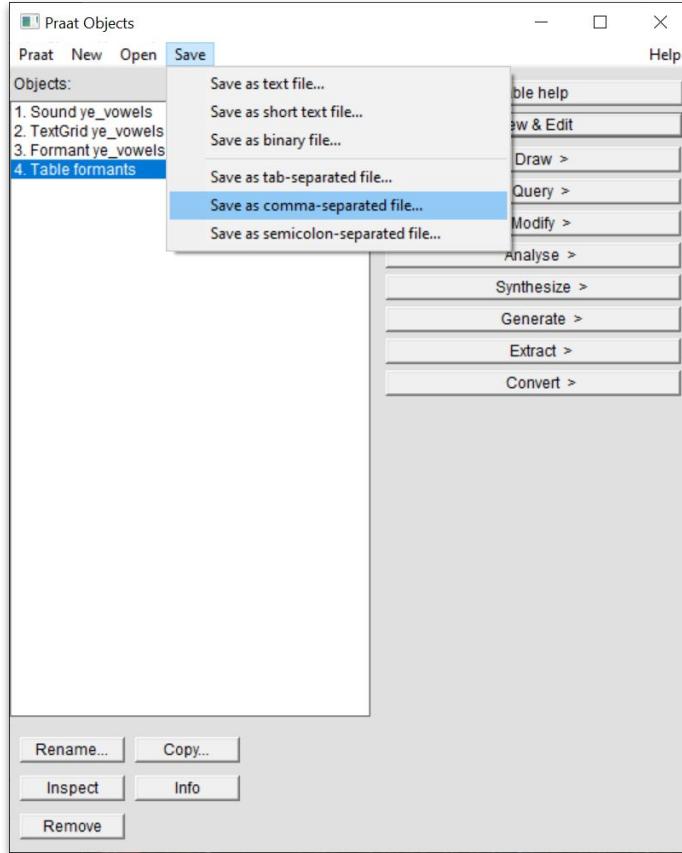
4. Table formants

File Edit Help

row	vowel	time_index	v_time	time_abs	F1	F2	F3
1	a	1	0	0.132	1152	2255	3786
2	a	2	0.025	0.157	695	1146	2217
3	a	3	0.05	0.182	717	1128	2236
4	a	4	0.075	0.207	654	1140	2243
5	a	5	0.1	0.232	738	1129	2230
6	a	6	0.125	0.256	695	1127	2212
7	a	7	0.15	0.281	675	1132	2220
8	a	8	0.175	0.306	764	1144	2231
9	a	9	0.199	0.331	682	1138	2208
10	a	10	0.224	0.356	609	1140	3050
11	a	1	0	0.865	758	1191	2316
12	a	2	0.052	0.916	764	1157	2318
13	a	3	0.104	0.968	714	1171	2323
14	a	4	0.155	1.02	736	1101	2335
15	a	5	0.207	1.072	670	1147	2310
16	a	6	0.259	1.124	661	1153	2329
17	a	7	0.311	1.176	652	1142	2323
18	a	8	0.363	1.227	713	1071	2316
19	a	9	0.415	1.279	623	1130	2281
20	a	10	0.466	1.331	467	1096	2892
21	i	1	0	1.706	276	2144	2761

- Extracted F1, F2, F3

Annotated Spectrum to F1, F2, F3

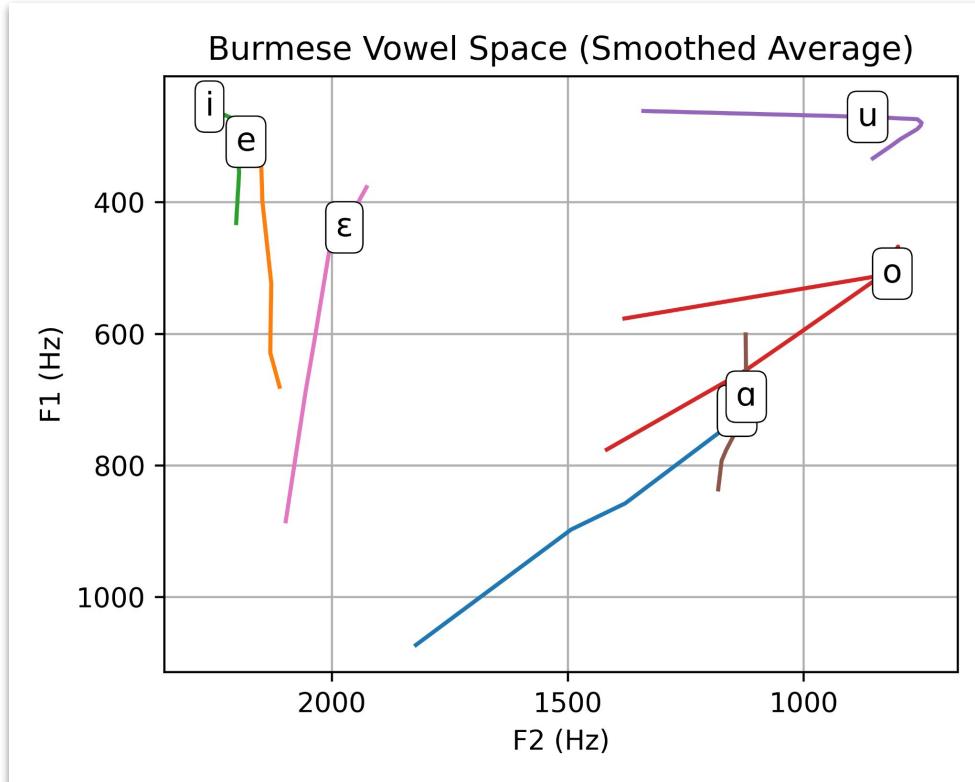


• ဖိုင် ကို သိမ်းပါ

Coding for Drawing Vowel Chart

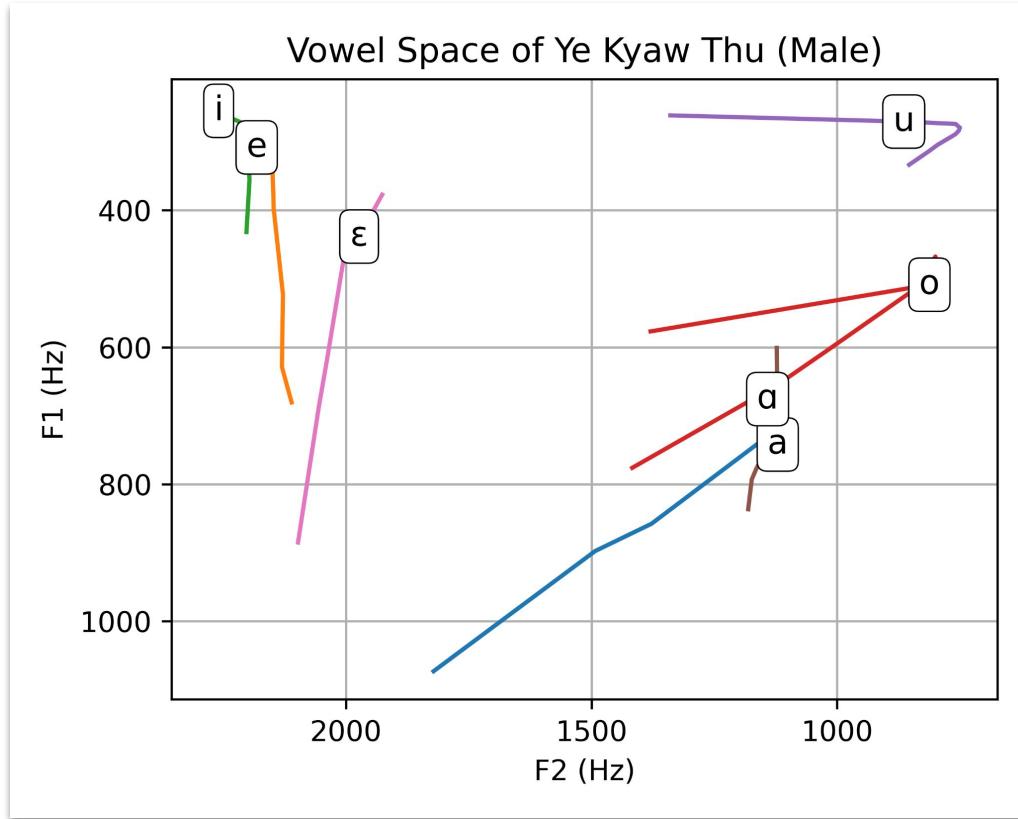
```
1  #!/usr/bin/env python3
2  #-*- coding: utf-8 -*-
3  """
4  Plot Burmese Vowel Space (F1 vs F2) using formant table
5  Written by Ye, LU Lab., Myanmar
6
7  - Supports stdin / --input CSV
8  - Labels vowels using IPA
9  - Rolling average (window=3) smoothing like the reference R script
10 - Plots one smoothed path per vowel
11
12 Usage:
13   python ./plot_vowel_space.py --input ye_formants_utf8.csv --output ./ye_vowel_space.png
14 """
15
16 import argparse
17 import pandas as pd
18 import matplotlib.pyplot as plt
19 from matplotlib.ticker import MultipleLocator
20
21 # IPA label map
22 IPA_MAP = {
23     'i': '\u0069',
```

Coding for Drawing Vowel Chart



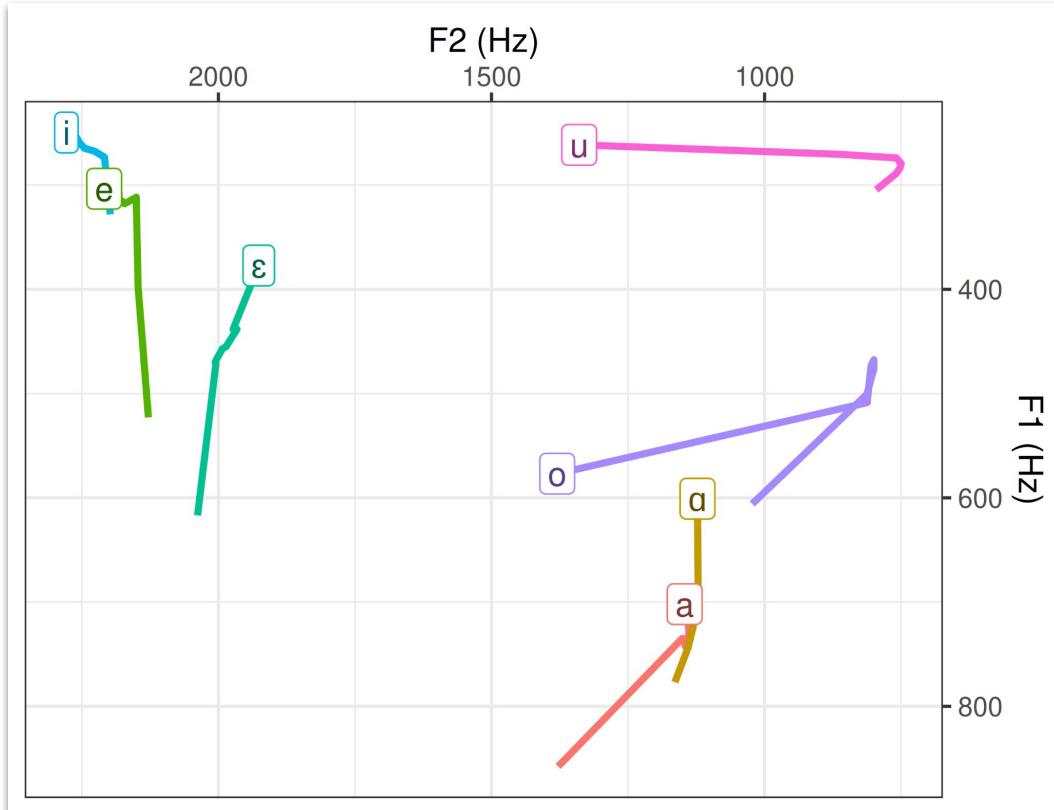
- လက်တွေမှာ လောယ်က ထပ်နေတာမျိုးလည်း ဖြစ်နိုင်တယ်

Coding for Drawing Vowel Chart



- Coding နဲ့
ဝင်ညိုထားတယ်

Coding for Drawing Vowel Chart (with R)



- R source code နဲ့
ဆွဲထားတာ
- R programming ကို
သုံးပြီး ဆွဲရင်တော့
graph က
ပုံအဆင်ပြလိမ့်မယ်
- ကိုယ်စက်ထဲမှာ R
programming
ထည့်ပြီး
ဆွဲချင်တဲ့သူတွေအတွေ
က R code ကိုလည်း
ရဲပေးထားပါမယ်

Conclusion

vowel	N tokens	F1_mean (Hz)	F2_mean (Hz)	F3_mean (Hz)
a (အော်)	20	757	1213	2393
e (အော်/ဧ)	20	374	2170	2660
i (အို/အော်)	40	279	2240	2847
o (အော်/ ဩ)	20	543	1041	2531
u (အော်/အူ)	40	282	940	2638
a (အော်)	20	694	1138	2380
ɛ (အဲ)	20	480	1985	2452

- ဆရာတဲ့ vowel space အသာ:
- Average ယူဝေးစွာ ပြု

Conclusion

- Phonetic နဲ့ ပတ်သက်ပြီး မိတ်ဆက်ပေးခဲ့တယ်
- မြန်မာစာ Phonetic သမုပ်းကြောင်းလည်း အကျဉ်း မိတ်ဆက်ပေးခဲ့တယ်
- IPA
- IPA to Speech TTS ကို အလွယ် လုပ်ပြုခဲ့တယ်
- Praat software ကို မိတ်ဆက်ပေးခဲ့တယ်
- အသံက တကယ်က မြန်မာ vowel အကုန်ကို အသံသွေးလည်း ရတယ်
- အားလုံးညီလုပ်ကြဖို့ လုအပ်တယ်
- တစ်ယောက်ချင်းစရှု vowel chart ကို assignment အနေနဲ့ လုပ်ကြရအောင်
- Praat ဖိုင်ရော vowel chart ဖိုင်ရော zip ဖိုင်နဲ့ zip လုပ်ပြီး တင်ကြပါ
- Graph မှာ title က ကိုယ့်နာမည်တပ်ပါ
- Zip ဖိုင်ကလည်း ကိုယ့်နာမည် တပ်ပါ

Thank you!

Q&A?

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