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# **Automated Speech Processing of Bengali using SPPAS software**

Brigette Bigi, Shakuntala Mahanta, Moumita Pakrashi

# What is SPPAS?

- **SPPAS: the automatic annotation and analysis of speech**, is a tool to automatically produce annotations including utterance, word, syllable and phoneme segmentations from a speech recording and its orthographic transcription.
- <http://www.sppas.org/>
- Resulting alignments are a set of annotated files in either:
  - .xra, the XML native file of SPPAS
  - .TextGrid, the native file format of the Praat software
  - .eaf, the native file format of ELAN
  - .CSV, ...

# Need of SPPAS in analysing Bengali prosody

- Scope for improving the naturalness of synthetic speech generated from present-day Bengali TTS systems.
- Intonation along with timing properties of speech prosody exercises the most prominent influence on enhancing such naturalness.
- To avoid time-consuming, manual analysis of large speech corpus, automatic analysis and annotation is essential.
- Addition of minimum linguistic resources to add a new language.

# Why SPPAS?

- Free and open source software maintained and developed regularly, especially designed for linguists.
- Multi-platform software that can be used in Windows, Mac, Linux OS platforms.
- Analysis/annotation output files compatible by conversion to most speech analysis software like Praat, Elan, Annotation Pro.
- Momel-INTSINT algorithm plugin incorporated for prosodic analysis.

# Primary functions

- **Annotate** - Produce automatic annotations from a recorded speech sound and its orthographic transcription and/or from a video.
- **Analyze** - Analysis of any annotated data: estimate statistical distributions, make requests, manage files, visualize annotations.
- **Convert** - SPPAS offers a file converter from/to a wide range of formats: xra, TextGrid, eaf, trs...

# Resources for addition of Bengali

The speech dataset used for training the models has been obtained from the Open Speech and Language resources created by Google that is freely available.

- Acoustic model

HMM based acoustic model has been created by Brigitte using an HTK toolkit, and implemented in the SPPAS latest version 4.1.

Trained with a set of 6 manually time-aligned files (about 18 seconds of speech) and 1,300 orthographically transcribed files (36 minutes of speech).

- Pronunciation Dictionary

Pronunciation dictionary and lexicon downloaded from Google database resources. The phonemes were then converted to SAMPA and the file format to HTK-ASCII by Brigitte. Numerals had to be transcribed in Bengali for adding them to the lexicon.

- Manual alignment

Manual alignment of some amount of speech data required to evaluate the success rate of the automatic alignment.

- Syllabification

Finally syllabification rules needs to be added in order to enable automatic syllabification for Bengali utterances.



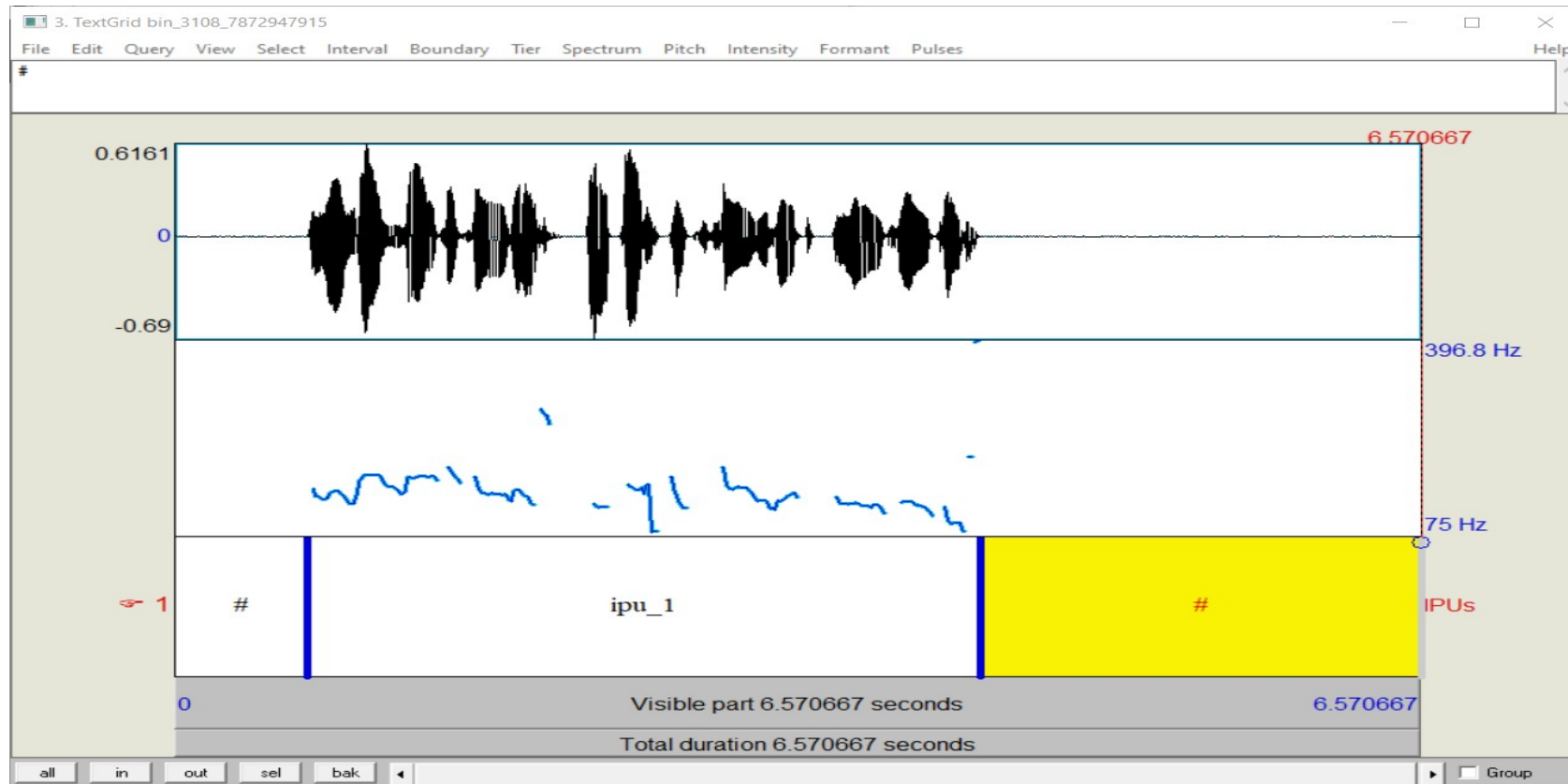
# Bengali speech data analysis using SPPAS

- Search for IPU (Inter-Pausal Units) - A semi-automatic annotation process. Output is an annotated file with one tier named “IPUs”. Silence intervals are labelled with the “#” symbol, and IPUs intervals are labelled “ipu\_” followed by the IPU number.



Figure 1: SPPAS window showing the IPU segmentation in speech waveform

- IPU segmentation in Praat textgrid



Perform manually the orthographic transcription

- Text Normalization - Unrestricted text with a variety of “non-standard” token types such as digit sequences, words, acronyms and letter sequences in all capitals, mixed case words, abbreviations, roman numerals, URL’s and e-mail addresses, needs to be normalized or rewritten using ordinary words.

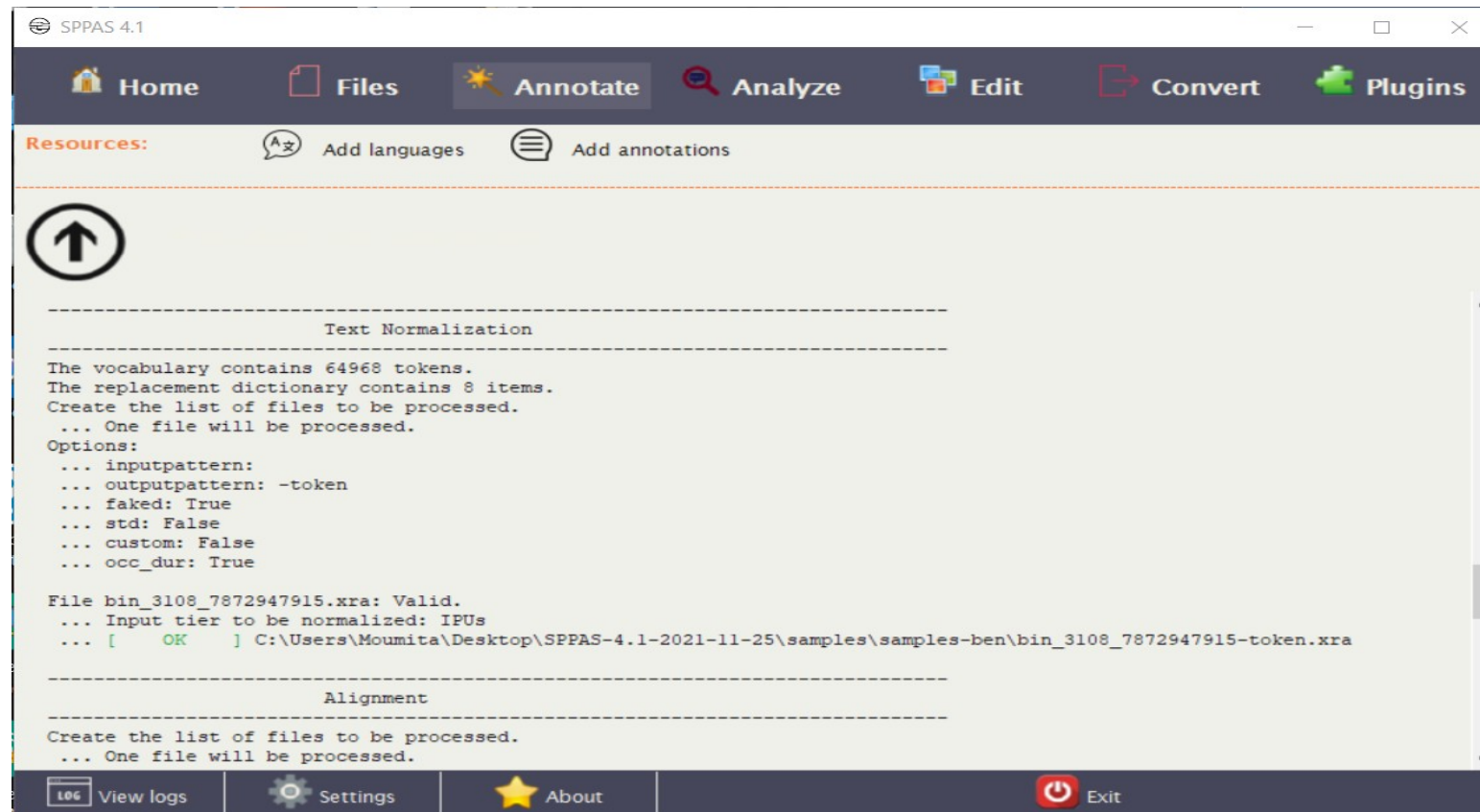


Figure 3: SPPAS annotation window showing the output results of text normalization

- Phonetization – Process of representing sounds with phonetic signs that produces a file with “-phon” appended to its name, i.e. “oriana1-phon.xra” for the previous example. This file contains only one tier with the resulting phonetization and with name “Phones”.
- Alignment – Alignment, also called phonetic segmentation, is the process of aligning speech with its corresponding transcription at the phone level.

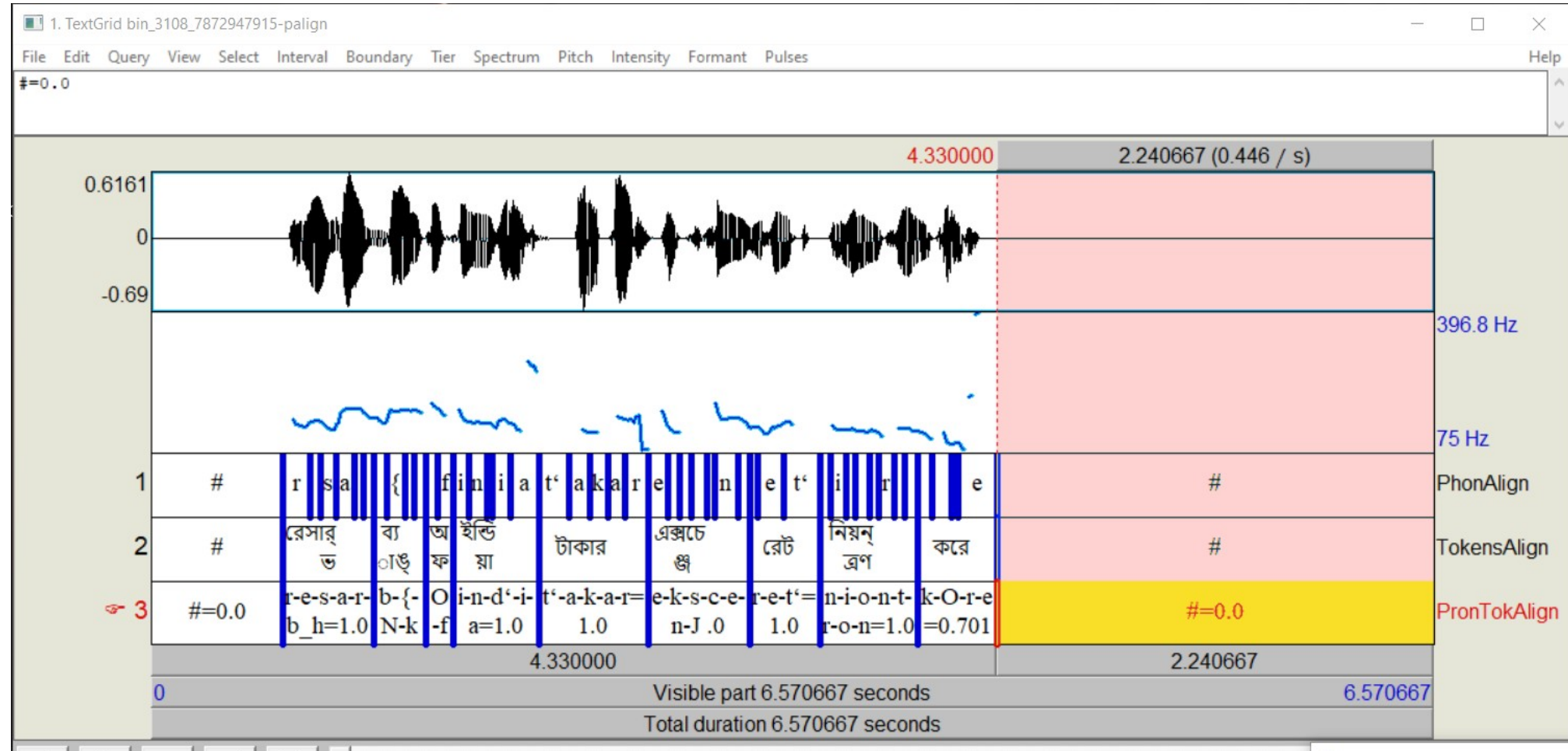


Figure 4: Praat window shows the final phonetized and aligned output results of a Bengali utterance.

- Descriptive statistical analysis – It allows to estimate the number of occurrences, the duration, etc. of the annotations of the analyzed tokens, and allows to save result in CSV (for Excel, OpenOffice, R, MatLab,...).

Annotation label tags:

Use only the tag with the best sco  
 Use alternative tags

Annotation durations:

Use only midpoint value  
 Add the radius value  
 Deduct the radius value

N-gram: 1

Summary Occurrences Total durations Mean durations Median durations Std dev. durations

Selected statistical distribution: summary

Label	Occurrences	Total durations	Mean durations	Median durations	Std dev. durator
0	138	0.0	0.0	0.0	0.0
0.5294117647058824	1	0.6779	0.6779	0.6779	0.0
0.7991071428571429	1	2.2407	2.2407	2.2407	0.0
1	117	2.9186	0.0249	0.0	0.215
1005	1	0.0	0.0	0.0	0.0
1005.0526315789474	1	0.19	0.19	0.19	0.0
1017	1	0.0	0.0	0.0	0.0
1026	1	0.0	0.0	0.0	0.0
1048	1	0.0	0.0	0.0	0.0
105	1	0.0	0.0	0.0	0.0
1056	1	0.0	0.0	0.0	0.0
1078	1	0.0	0.0	0.0	0.0
1093	1	0.0	0.0	0.0	0.0
11	4	0.0	0.0	0.0	0.0
1117	1	0.0	0.0	0.0	0.0
1133	1	0.2021	0.2021	0.2021	0.0
1142	1	0.0	0.0	0.0	0.0
1149	1	0.0	0.0	0.0	0.0
1150.5	1	0.08	0.08	0.08	0.0
1160	1	0.0	0.0	0.0	0.0
1172	1	0.0	0.0	0.0	0.0
1192	1	0.0	0.0	0.0	0.0
1193	1	0.0	0.0	0.0	0.0

Save Okay

Figure 5: SPPAS window showing the statistical analysis output results of durational measurements.

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Thank you!