**Project: Clustering tone sandhi patterns in Xiangshan Chinese**

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**General description**: Identify categorical tone contours using polynomial coefficients clustering in disyllables and trisyllables in Xiangshan Chinese, a low-resource Northern Wu Chinese variety.

**Purposes of this project:**

In this project, our objective is to utilise polynomial coefficients for clustering F0 to figure out possible sandhi patterns (f0 contours) in disyllables and trisyllables in Xiangshan. I am particularly interested in comparing the outcomes of this approach with those obtained through longitudinal *k-*means clustering (which does not model the temporal pattern of f0 countours), and in learning about the benefits/limitations of both approaches. I would also be interested in exploring different methods that could enhance the reliability of clustering f0 contours. A perceptual categorisation was conducted for the Xiangshan, which can probably serve as a reference point for evaluating the clustering solution.

**Background:**

**Monosyllabic tones in Xiangshan**

Xiangshan has 6 tones in total, namely HH, HL, LHL, LH, Hq, and LHq. Below is a minimal list of the tones and the audio recording of it. There is a *duration contrast* in the tones. The first 4 tones are called non-checked tones. They are longer in duration and always end with a Vowel or a Nasal consonant. The last 2 tones are called checked tones. They are shorter in duration and always end with a Glottal stop (that’s why they are conventionally transcribed with a ‘-q’ to indicate the glottal stop ending). Moreover, there is a *register (pitch height) contrast* in tones. The three High-register tones HH, HL, and Hq only co-occur with a voiceless onset consonant, i.e., [p, t] in this minimal list, and the three Low-register tones LHL, LH, and LHq only co-occur with a voiced consonant, i.e., [b, d] in this minimal list. Therefore, strictly speaking, there is no genuine ‘minimal list’ of all the tones, as they are associated with different syllable structures or onset consonant types.

**A white and blue object with a blue circle

Description automatically generated**

**Tone sandhi in Northern Wu Chinese**

Tone sandhi refers to categorical changes of tones in conditioned contexts. It can change one tone into another existing tonal category, or generate new tones. In *Northern Wu Chinese*, where Xiangshan belongs to, there is a well-known *‘tone spreading’* phenomenon in most lexical words and phrases. An example in Shanghai Wu Chinese, the most well-studied Wu language, is shown below. In the Noun Phrase ‘fried rice’, the two syllables respectively bear a 34 (high-rising) tone and a 13 (low-rising) tone when they are pronounced in isolation. In combination, the non-initial tone gets deleted, and the initial tone spreads to the whole phrase in a left-to-right one-to-one association fashion. Here since the initial tone 34 has two tonal features, 3 and 4, each of them is associated with one syllable, resulting in a 3+4 (a mid-level plus a high-level tone) tone pattern over the whole disyllable. In a nutshell, such ‘tone spreading’ mechanism essentially expands the initial tone over the whole sandhi domain. \*Note that neither 3 or 4 exist in Shanghai tone inventory as a stand-alone monosyllabic tone.

|  |  |
| --- | --- |
|  | *tsʰɔ vɛ* 炒饭 *‘fried rice’* |
| Original tones | 34 13 |
| Tone deletion | 34 |
| Tone spreading | 3 4 |

So far, it seems that the sandhi mechanism in Northern Wu region is quite straightforward: as long as the initial tone is settled, we can predict the sandhi output of the whole word/phrase.

However, things are always more complicated than this in reality. Later studies found that in many Northern Wu languages, other factors can diversify the sandhi outputs, such as the historical tonal categories of the initial tones, individual speakers, phrase lengths, etc. It means that various sandhi patterns can be found even when the initial tone is the same. And despite the dominance of the initial tone, some varieties start to allow the non-initial tones to play a role in determining the tone sandhi realisations. Therefore, more research has to be done to examine the variations in sandhi patterns and their potential causes in various Wu languages.

**Research questions:**

My PhD research explores the tone sandhi patterns in Xiangshan, aiming to provide new acoustic data, as well as new evidence for tone sandhi to this field. There are mainly 2 questions addressed in the project:

1. What are the possible distinct tone sandhi patterns in Xiangshan Wu Chinese?
2. What are the possible factors contributing to such variations?

In terms of our current clustering project, I believe only the first question will be addressed.

**Materials:**

Two sets of data were elicited from 8 Xiangshan native speakers aged around 50. One set consists of disyllables and the other trisyllables. Around 52 disyllables and 44 trisyllables were collected from each speaker, leading to 416 disyllables and 352 trisyllables in total. Only non-checked tones are involved, i.e., HH, HL, LHL, LH. The materials cover all the potential tone combinations (meaning the original tone of each syllable) starting with a HH tone or a LHL tone. Thus, for the disyllables, we have HH-HH, HH-HL, HH-LHL, HH-LH, LHL-HH, LHL-HL, LHL-LHL, LHL-LH tone combinations, with ‘-’ denoting the syllable boundary. Take the HH-HH combination for example, both syllables have a HH tone when they are pronounced in isolation, and we aim to explore how the tones change when they are pronounced as a whole.