

## **Studying the interaction between irregular voice quality and lexical tones with recurrence analysis and functional mixed models**

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In several languages non modal voice qualities are contrastive. Our work focuses on the pattern of vocal fold vibration in vocalic segments which can be implemented either as creakiness or as instances of glottal stops. Of particular interest is the co-occurrence of non-modal phonation and lexical tones because the two features can impose competing constraints on laryngeal mechanisms. Here we propose a method to study the interplay between irregular vibration of vocal folds (as measured from the EGG signal) and lexical tones. The method consists of two parts: First, we characterize the evolution over time of the regularity of vocal folds vibration through a recently proposed modification of recurrence analysis (Lancia and Tiede, 2012). This method being robust to non stationarities in the EGG signal is particularly suitable to analyze signals whose F0 is expected to vary over time. Second, the curves describing the changes in regularity are treated as the dependent variable of a Functional Mixed Model (Morris and Carrol, 2006). This statistical method allows us to observe how the shape of the curves varies as a function of known factors (i.e. tones, phonation and vowel height) which constitute the predictors of the model. Other factors (both linguistic and non linguistic) that potentially affect the curves (e.g. words, speaker identity, etc.) can be treated as random terms in the model. The method has been succesfully tested with synthetic laryngeal vibrations whose variability and F0 were systematically controlled. We apply this approach to the analysis of Yalálag Zapotec (three speakers, one male and two females) a language that contrasts high low and falling tones and laryngealization on vowels (Avelino, forthcoming).

### References

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