F1 and F2 measurements for French oral vowel with a new pneumotachograph mask

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Introduction

- Combining acoustic and aerodynamic acquisitions is particularly challenging in experimental phonetics.

- Several devices available to record aerodynamic data use different masks but it seems each time acoustic disturbance occurs (Ghio & Teston, 2002)

- To solve this challenge : a pneumotachograph was developed at Laboratoire de Phonétique et Phonologie (LPP) uses a mask made of synthetic fibers, instead of conventional rigid materials. This mask is acoustically almost transparent, and thus the radiated speech sound through the mask is almost free from acoustic distortions (Honda & Maeda, 2008; Vaissière & *al.,* 2010).

Objectives

The goal of the current study is to validate that the acoustics of the fiber masks get closer to the acoustics of recording without a mask, that is to say without distortions.

For that we compare recordings with only a microphone with recordings with a rigid mask: Rothenberg (Rothenberg, 1977) and EVA2^{TM}(Teston et Galindo, 1995); and with our flexible mask .

EVA mask

Rothenberg mask

Flexible mask

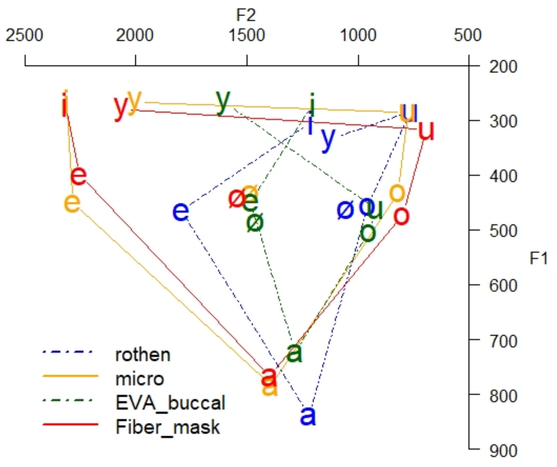
Methods

1) **Corpus :**
    1) Sustained vowels
    2) Vowels in logatoms
    3) Vowels in sentences

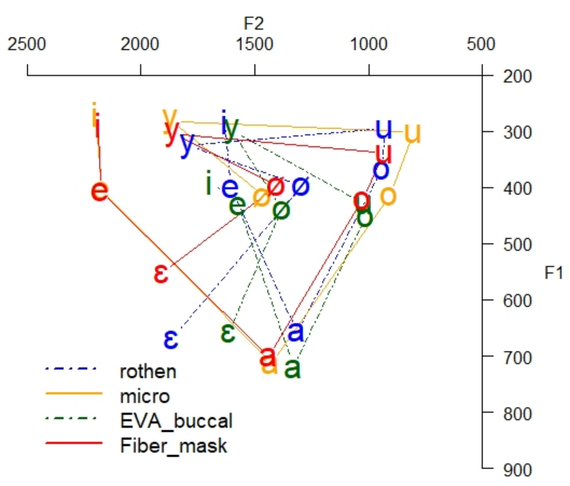
2) **Speakers :** two female French native speakers
3) **Recordings :**
    1) Acoustic-only microphone
    2) Acoustic from the rigid oral mask of EVA2^{TM}
    3) Acoustic from the fiber mask
    4) Acoustic from the Rothenberg mask
4) **F1 and F2 values**
   Spectral slices

Results

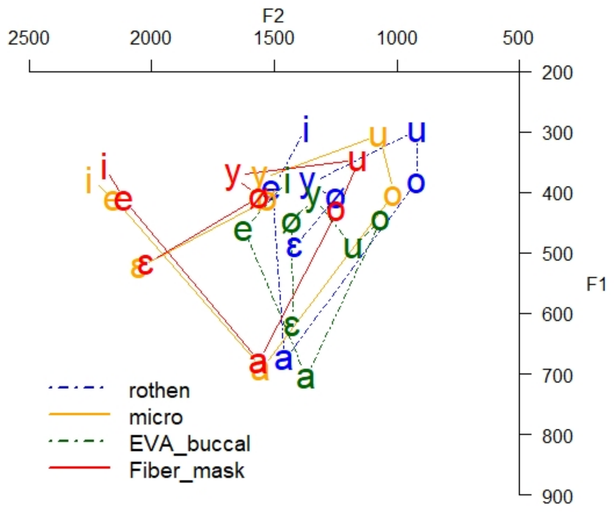
- We observed thanks to the vowel triangle a strong similarity between the formant structure of the fiber mask (Fiber_mask) and of our acoustic recording (micro) for every type of vowels.



a) Sustained vowels



b) vowels in logatoms



c) Vowels in sentences

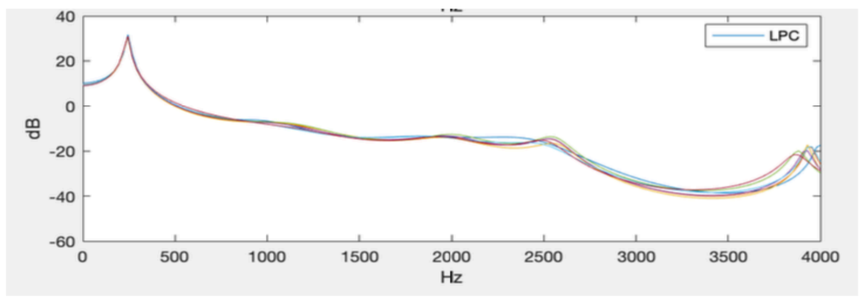
Figure 1: Vowel triangle on the F1-F2 space. F1 and F2 average over two female speakers are indicated for four recording conditions: with the Rothenberg mask (in blue dash-dot line), microphone without a mask (in orange), with rigid EVA mask (in green dash-dot line) and with the fiber mask (in red). Sustained vowels, vowels in logatoms and in sentences are shown respectively in a), b) and c).

- Records with EVA2TM (EVA_buccal) show a really distinct structure and a highly deformed triangle.

- We found significative differences between the Rothenberg mask (rothen) and our fiber mask

A spectral analysis was done on the sustained vowel [y] from the EVA and fiber mask recording. We can see a spectral attenuation in frequencies above 2kHz for the EVA recordings.

a)



b)

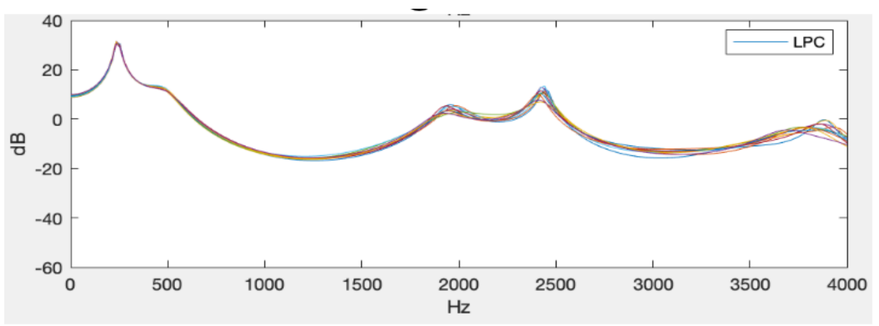


Figure 2: LPC spectrum from the EVA in a) and the fiber mask in b) recordings

Conclusion

The fiber mask is a credible device to preserve acoustics. Other futures studies should compare the fricative acoustics and aerodynamics.