

Fiche de projet tutoré / Project form

Coordination of vocal folds activity with supra-glottal cavities for synthesizing French consonants

Encadrement / Supervisors

1. équipe, laboratoire / team, lab : MultisSpeech (LORIA)

1. encadrant-e principal-e (nom, email) / main supervisor (name, email) :

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Description / Description

1. projet global/global project

This project comes within the framework of a physical approach to speech synthesis by simulating the acoustic process of speech production instead of using a pre-recorded speech database.

We therefore start from the shape of the vocal tract given by Magnetic Resonance Imaging (MRI), either static to have a precise knowledge of the three-dimensional shape of the vocal tract, or dynamic to get the evolution of the shape of the vocal tract over time controlled by the movements of the jaw, tongue, lips and other articulators.

The second contribution is the vibration of the vocal cords that excites the resonant cavities of the vocal tract, and thus makes it possible to generate the acoustic signal as it is perceived at the exit of the lips.

We have already developed a fairly complete architecture that covers both the modelling of the geometric deformation of the vocal tract over time (developed in C++), and the resolution of acoustic equations (developed in Matlab). More details and results obtained are available [here](#) on the acoustic simulations.

Over the past two years we have made great progress in simulating fricative sounds, such as sound [s] in the French word "assis" or [z] in the word "Asie". In particular, we relied on measurements of the opening of the vocal cords obtained using a non-invasive technique (electro-glottography) with a very high sampling frequency (10kHz). These measurements revealed a gesture of vocal cord spacing centered in the middle of the fricative, and these data were then successfully used in the numerical simulations.

The project we are proposing this year is aimed at the production of occlusive sounds, such as [k] in the French word "coup" or [g] in the word "goût".

2. biblio. UE 705 (semestre 7)

Reading of articles and mastery of simulation techniques.

3. réalisation. UE 805 (semestre 8)

The project we are proposing this year is aimed at the production of occlusive sounds, such as [k] in the French word "coup" or [g] in the word "goût". The work will cover several aspects:

- electro-glottography measurements taken at the LPP laboratory in Paris,
- use of MRI data to measure the shape of the vocal tract during occlusive production,
- construction of a coordination scheme between the evolution of the shape of the vocal tract and the spacing of the vocal folds,
- use of digital simulations to produce the acoustic signal.

Informations diverses : matériel nécessaire, contexte de réalisation /

Various information: material, context of realization

The project involves the use of numerical simulations with Matlab, and it is very likely that ElectroPhotGlottography data will be acquired in LPP (Paris) or at LORIA.

This work will require some computer developments in C++ and/or Matlab to implement numerical simulations and MRI data analysis using software already developed.

Livrables et échéancier / Deliverable and schedule

- November-December : Bibliography, discovery of the Matlab simulation tools and of tools for delineating contours in MRI films
- February : Annotations of films in the region of consonants, possibly recording of vocal folds activity via EPGG
- March : Construction of coordination scenarios between vocal folds and running simulations
- April-May: analysis of the results, report writing and defense

Bibliographie /References (max. 4-5)

- BENJAMIN ELIE, YVES LAPRIE. – « Acoustic impact of the gradual glottal abduction on the production of fricatives: A numerical study ». *Journal of the Acoustical Society of America* 142, 3 (septembre 2017), pp. 1303–1317.
- Y. LAPRIE, R. SOCK, B. VAXELAIRE, B. ELIE. – « Comment faire parler les images aux rayons X du conduit vocal? ». – In : *Actes du Congrès Mondial de la Linguistique Française*. – Berlin, juillet 2014.
- Pertti Palo “*A Review of Articulatory Speech Synthesis*”. Master's Thesis - <https://pdfs.semanticscholar.org/2a74/b26595323e3b4dbcc9c61595a6781702ec18.pdf>