

# ADVANCES IN LOCAL INFERENCE FOR FUNCTIONAL DATA WITH APPLICATION TO TONGUE PROFILE ANALYSIS.

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The talk will focus on the statistical comparison of ultrasound tongue profiles pertaining to different allophones pronounced by the same speaker (Vietti et al. 2015). Stimulated by this application we will introduce a general framework for *multi-aspect local non-parametric* null-hypothesis testing for functional data (Pini and Vantini 2016 and 2017, Pini et al. 2017). Sagittal tongue profile records can be modelled indeed as functions varying on a spatio-temporal domain. In detail: *multi-aspect* pertains to the fact the procedure allows the simultaneous investigation of different data features (i.e., aspects) like tongue vertical position, slope, concavity, velocity, and acceleration; *local* pertains instead to the fact the procedure can impute the aspect-specific rejection of the null hypothesis to aspect-specific regions of the spatio-temporal domain; finally, *non-parametric* refers to the fact that the procedure is permutation-based and it is thus finite-sample exact and consistent independently on data Gaussianity. For ease of clarity, the focus will be on the two-population test. Nevertheless, the approach is flexible enough to be adapted to more complex testing problems like functional ANOVA and functional linear regression.

**Keywords:** Functional data analysis, non-parametric inference, local inference, multi-aspect inference, articulatory phonetics.

## References:

- A. Pini and S. Vantini (2016), The interval testing procedure: a general framework for inference in functional data analysis. *Biometrics*, 72, 835–845.
- A. Pini and S. Vantini (2017), Interval-Wise Testing for Functional Data, *Journal of Nonparametric Statistics*. To appear.
- A. Pini, L. Spreafico, S. Vantini, A. Vietti (2017), Multi-aspect local inference for functional data: analysis of ultrasound tongue profiles. Tech. Rep. MOX, Dept. of Mathematics, Politecnico di Milano.
- A. Vietti, L. Spreafico, and V. Galatà (2015), An ultrasound study of the phonetic allophony of Tyrolean /r/. *ICPhS 2015 Proceedings*.