

PhD thesis: “From grapheme to gesture. Linguistic contributions for an articulatory based text-to-speech system” (Original: Do grafema ao gesto. Contributos linguísticos para um sistema de síntese de base articulatória)

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1. Committee

- Ana Maria Vieira da Silva Viana Cavaleiro, University of Aveiro
- João Manuel Nunes Torção, University of Aveiro (supervisor)
- Plínio de Almeida Barbosa, Department of Linguistics Instituto de Estudos da Linguagem/Unicamp
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- Maria Aldina de Bessa Ferreira Rodrigues Marques, Instituto de Letras e Ciências Humanas, University of Minho
- António Joaquim da Silva Teixeira, University of Aveiro (supervisor)

Qualification: Approved by unanimity

University: University of Aveiro

2. Abstract

Motivated by the central purpose of contributing for the construction, in the long term, of a complete text-to-speech system based in articulatory synthesis, we develop a linguistic model for European Portuguese (EP), based on TADA system (TAsk Dynamic Application), that aimed at the automatic attainment of the articulators trajectory from the input text.

The specification of this purpose determined the development of a set of tasks, namely the 1) implementation and evaluation of two automatic syllabification systems and two grapheme-to-phoneme (G2P) conversion systems, in view of the transformation of the input in an appropriate format to the TADA; 2) the creation of a gestural database for the EP sounds, in so that each phone obtained at the output of the g2p system could have correspondence with a set of articulatory gestures adapted for EP; 3) the dynamic analysis of nasality, on the basis of an articulatory and perceptive study.

The two automatic syllabification algorithms implemented and tested make appeal to phonological knowledge on the structure of the syllable, being the first one based in finite state transducers and the second one a faithful implementation of Mateus & d'Andrade (2000) proposals. The performance of these algorithms - especially the second - was similar to the one of other systems with the same potentialities.

Regarding grapheme-to-phone conversion, we follow a methodology based on manual rules combined with

an automatic learning technique. The evaluation results of this system motivated the exploitation of others automatic approaches, finding also to evaluate the impact of the syllabic information integration in the systems.

The gestural description of the European Portuguese sounds, anchored on the theoretical and methodological tenets of the Articulatory Phonology, was based essentially on the analysis of magnetic resonance data (MRI), from which all the measurements were carried out, aiming to obtain the quantitative articulatory parameters. The several gestural configurations proposed have been validated, through a small perceptual test, which allowed identifying the main underlying problems of the gestural proposal. This work provided, for the first time to PE, the development of a first articulatory based text-to-speech system.

The dynamic description of nasal vowels relied either on the magnetic resonance data, for characterization of the oral gestures, either on the data obtained through electromagnetic articulography (EMA), for the study of the velum dynamic and of its relation with the remaining articulators. Besides that, a perceptive test was performed, using TADA and SAPWindows, to evaluate the sensibility of the Portuguese listeners to the variations in the height of velum and alterations in the intergestural coordination. This study supported an abstract interpretation (in gestural terms) of the EP nasal vowels and allowed also to clarify crucial aspects related with its production and perception.

3. Curriculum Vitae

a. PERSONAL DETAILS

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b. EDUCATION

- 2009 - PhD in Linguistics, University of Aveiro, Portugal.
- 2002/ 2003 – Post-graduation in Portuguese Studies, Department of Languages and Cultures, University of Aveiro, Portugal.
- 1997/ 2002 – Degree (licenciatura) in “Línguas e Literaturas Clássicas e Portuguesa”, Faculty of Arts, University of Coimbra, Portugal.

c. RESEARCH INTERESTS

Articulatory Phonology
Experimental Phonetics
Nasal Vowels
Articulatory Speech Synthesis

Conference on Speech Communication and Technology,
Lisboa, 2005.

d. TEACHING

- *Articulatory and Acoustic Phonetics II*, School of Health, University of Aveiro: 2007/ 2009- lectures and laboratory classes; 2005- 2007 – laboratory classes.
- PLE (Portuguese as a Foreign Language) courses, Languages and Literatures Department, University of Aveiro: 2004 – level I (Beginners Course) and level II (Intermediate Course); 2003 - level I (Beginners Course), level II (Intermediate Course) and international summer course (intermediate level).
- Portuguese language at High School: November/ December 2003 - Escola Secundária de Estarreja; September/ November 2002 - Escola E/B, 2.3 Dr. Acácio de Azevedo de Oliveira do Bairro; 2001 - Escola Secundária de Cantanhede.
- Latin Language at High School: 2001 - Escola Secundária de Cantanhede

e. PARTICIPATION IN RESEARCH PROJECTS

Portugal R&D Project "HERON – A Framework for Portuguese Articulatory Synthesis Research" (POS/PLP/57680/2004), 2004-2007.

f. SELECTED PUBLICATIONS

- Oliveira, C., Teixeira, A., Martins, P., "Speech Rate Effects on European Portuguese Nasal Vowels", Interspeech'2009 - 10th Annual Conference of the International Speech Communication Association, Brighton, UK. (Accepted).
- Teixeira, A., Martins, P., Carbone, I., Oliveira, C., Silva, A., "An MRI Study of European Portuguese Lingual Coarticulation", capítulo de livro a publicar por uma editora internacional (to appear).
- Teixeira, A., Oliveira, C., Barbosa, P., "European Portuguese Articulatory Based Text-to-Speech: First Results" in António Teixeira, Vera Lúcia Strube de Lima, Luís Caldas de Oliveira and Paulo Quaresma (Eds), Computational Processing of the Portuguese Language, Springer, 2008 .
- Oliveira, C., Teixeira, A., "On Gestures Timing in European Portuguese Nasals", Trouvain, J. and Barry, W.J. (Cord.), Proceedings of 16th International Congress of Phonetic Sciences. Saarbrücken, Germany, 2007, 405-408.
- Teixeira, A., Oliveira, C., Moutinho, L., "On the Use of Machine Learning and Syllable Information in European Portuguese Grapheme- Phone Conversion" in R. Vieira, P. Quaresma, Maria G. V. Nunes, N. Mamede, C. Oliveira, M. C. Dias (Eds), Computacional Processing of the Portuguese Language, Springer, 2006, 212-215.
- Oliveira, C., Moutinho, L., Teixeira, A., "On European Portuguese Automatic Syllabification", Proceedings of Interspeech'2005 – Eurospeech- 9th European