SPECOM 2005

10th International Conference
SPEECH and COMPUTER

17 – 19 October, 2005
Patras, Greece

PROCEEDINGS

Organizers:

University of Patras
Wire Communications Laboratory
Patras, Greece

Moscow State Linguistic University
Moscow, Russia

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General Chair's Message

On behalf of the Organizing Committee of SPECOM 2005, I would like to welcome you to Patras and to the conference on Speech and Computer.

This year SPECOM celebrates its 10th anniversary. It started in 1996 in St Petersburg, organized by the St. Petersburg Institute of Informatics and Automation of the Russian Academy of Sciences (SPIIRAS) and since then was annually held alternatively in Moscow, organized by the Moscow State Linguistic University (MSLU) and in St Petersburg with the only exception of 1997 when it was held in Cluj-Naboca (Romania).

The selection of Patras for the current SPECOM has not been accidental. The University of Patras has a collaboration agreement with MSLU and the Wire Communications Laboratory (WCL) which is organizing this event jointly with MSLU, has actively participated in previous SPECOMs. Nevertheless, the main reason was to expand SPECOM beyond Russia and promote relations between scientists from former USSR countries with colleagues from other parts of the world. In particular, to promote participation of East European scientists in the International Speech Communication Association (ISCA). ISCA welcomes everybody active in the broad field of speech communication. I am confident that SPECOM 2005 will be the catalyst for gradually approaching the mentioned goals in the next years.

In the three days of SPECOM 2005, original work in a broad spectrum of subjects will be presented. The technical programme includes 168 regular papers contributed by 376 authors from 37 countries. Actually, more than 220 papers were submitted which were reviewed by a 27 member international scientific committee and the best were selected. These are arranged in 7 oral and 14 poster sessions. Emphasis has been given to poster sessions so that the participants will have more flexibility in choosing the papers of their interest and more time in discussing the subjects with the authors. Apart from the regular papers, there are 13 plenary talks by distinguished, invited speakers from 9 countries. The high number of these talks is a novelty which aims at surveying the evolution of speech and language research and highlighting its perspectives.

I would like to thank all the members of the Organizing Committee, especially Nikos Fakotakis, Rodmonga Potapova and Evangelos Dermatas, the personnel of WCL, especially Panagiota Bobolas, Rania Doufeksi, Ilias Kotinas, and all the members of the Scientific Review Committee. Furthermore, I would like to extend my best thanks to the sponsors and supporters of SPECOM 2005:

- The University of Patras and the WCL in particular
- The Moscow State Linguistic University (MSLU)
- The Speech Technology Center, Moscow
- The Technical Chamber of Greece
- The International Speech Communication Association (ISCA)
- The Similar Network of Excellence

I hope you will have a pleasant stay in Patras and that SPECOM 2005 will prove useful to all participants.

Professor George Kokkinakis
General Chair

Co-Chair's Message

of the co-chair of SPECOM '2005
President of Moscow State Linguistic University,
Academician of Academy of Educational Sciences
Irina Khaleeva

Dear Ladies and Gentlemen, dear friends!

I am happy to greet you on behalf of my Russian colleagues regarding the 10th International Conference on Speech and Computer "SPECOM '2005". For the first time this scientific event is organized by two teams: from Greece and from Russia. And it would be desirable to continue this art of cooperation in the future and to organize SPECOMs in different countries of Europe.

I hope that this conference will be rich of interesting and perspective ideas and will contribute many valuable results to the theory and practice of speech and computer science.

Irina Khaleeva

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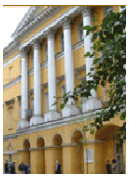

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TECHNICAL PROGRAMME AT A GLANCE

Time	Monday	Tuesday	Wednesday
9:00-9:30	**Opening Ceremony**	Keynote Speech 2: **Roger Moore:** *Cognitive Informatics: The Future of Spoken Language Processing?*	Invited Speech 6: **Lin-Shan Lee:** *Chinese Spoken Document Understanding and Organization --An Initial Prototype System for Efficient Browsing and Retrieval*
9:30-10:00	Keynote Speech 1: **Sadaoki Furui:** *50 years of progress in speech and speaker recognition*		Invited Speech 7: **Gerhard Rigoll:** *Speech Emotion Recognition Exploiting Acoustic and Linguistic Information Sources*
10:00-10:30		Invited Speech 4: **Hiroya Fujisaki:** *The Interplay Between Physiology, Physics and Phonetics in the Production of Tonal Features of Speech of Various Languages*	Invited Speech 8: **Taras Vintsiuk:** *Multi-Level Multi-Decision Models in ASR*
10:30-10:50	**Coffee Break**		
10:50-11:20	Invited Speech 1: **Louis Pols:** *Vowel Recognition and (Adaptive) Speaker Normalization*	Invited Speech 5: **Jens Blauert:** *30 Years of Speech-Technology Research at the Institute of Communication Acoustics – and the Philosophy Behind It*	Invited Speech 9: **Pavel Skrelin:** *Labeling Problems in Speech Corpus Creation*
11:20-13:00	**Oral Session**	**Oral Session**	**Oral Session**
	OS1: Speech Recognition	*OS4: Speech Synthesis*	*OS5: Speaker Recognition*
	Poster Sessions	**Poster Sessions**	**Poster Sessions**
	PS1: Natural Language Processing	*PS7: Speech Recognition II*	*PS9: Speech and Language Resources*
	PS2: Speech Synthesis I	*PS8: Speaker Recognition*	*PS10: Speech Analysis*
13:00-14:00	**Lunch**		
14:00-14:30	Invited Speech 2: **Rodmonga Potapova:** *Identification of prosodic features of emotional state of a speaker*	**Free Afternoon** **Excursion to Ancient Olympia** **(optional)**	Invited Speech 10: **Jury Marchuk:** *Editing Machine Translation: New Problems*
14:30-16:10	**Oral Session**		**Oral Session**
	OS2: Speech Production and Perception		OS6: Dialogue Systems
	Poster Sessions		**Poster Sessions**
	PS3: Speech Recognition I		PS11: Speech Synthesis II
	PS4: Multimodal Systems		PS12: Applications I
16:10-16:30	**Coffee Break**		**Coffee Break**
16:30-17:00	Invited Speech 3: **Eva Hajicova:** *Written and Spoken Language: The Case of Ambiguities*		Invited Speech 11: **George Kokkinakis:** *Speech & Language R & D Activity at the Wire Communications Laboratory 1969-2004*
17:00-18:40	**Oral Session**		**Oral Session**
	OS3: Speech Analysis - Coding		OS7: Multimodal Systems
	Poster Sessions		**Poster Sessions**
	PS5: Dialogue Systems I		PS13: Dialogue Systems II
	PS6: Speech Production and Perception		PS14: Applications II
18:40-18:50	**Break**		**Break**
18:50-20:30	**Welcome Reception**		**Closing Ceremony**
20:00-23:00		**Banquet**	

Statistics of the SPECOM 2005 Proceedings

Keynote papers: 2
Invited papers: 11
Regular Papers: 168
Total number of papers: 181
Authors: 376
Countries of authors: 37
Oral sessions: 7
Poster sessions: 14

Number of contributions per country:

COUNTRIES	Papers	COUNTRIES	Papers
Austria	**2**	Mexico	**3**
Belarus	**1**	Norway	**3**
Belgium	**4**	Poland	**5**
Canada	**2**	Portugal	**2**
Chile	**3**	Romania	**1**
China	**2**	Russia	**32**
Czech Republic	**19**	Spain	**7**
Denmark	**1**	Sweden	**2**
Estonia	**3**	Taiwan	**2**
Finland	**8**	Thailand	**1**
France	**5**	The Netherlands	**3**
Germany	**21**	Turkey	**1**
Greece	**14**	UK	**7**
India	**8**	Ukraine	**3**
Iran	**6**	Vietnam	**2**
Ireland	**3**	USA	**2**
Italy	**1**	Total*	**200**
Japan	**18**		
Korea	**1**		
Lithuania	**1**		
Malaysia	**1**		

* Included in the above number are 19 double-country papers

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Chair: Hiroya Fujisaki, University of Tokyo, Japan

ORAL SESSION: OS3
Speech Analysis and Processing - Coding
Chair: Jens Blauert, Institute of Communication Acoustics, Ruhr-Universität Bochum, Germany

POSTER SESSION: PS9
Speech and Language Resources
Chair: Niels Ole Bernsen, Natural Interactive Systems Laboratory, University of Southern Denmark

POSTER SESSION: PS10
Speech Analysis and Processing
Chair: John Mourjopoulos, Wire Communications Laboratory, Electrical and Computer Engineering Dept., University of Patras, Greece

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Poster Session: PS6
Speech Production and Perception

Chairperson
Pavel Skrelin
Department of Phonetics, Saint-Petersburg State University, Russia

Four degrees of openness in some Catalan vowels

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Abstract

As there is a lack of acoustic description of dialectal Catalan vowels in the literature, this paper wants to supply a description of the vowels proper of different dialects of this Romance language from an experimental and contrastive approach. The paper aims at describing de differences in quality of the vowels [e], [ɛ], [o] and [ɔ] in *barceloní, lleidatà, mallorquí* and *southern valencià* (the dialects spoken in Barcelona, Lleida, Majorca and Southern Valencian Country, respectively) through the analysis of F1 and F2 of these sounds in a symmetrical [p] V [p] consonant context.

1. Introduction

Catalan is a Romance language spoken by about seven million inhabitants of Spain, distributed over Catalonia, Valencia, part of Aragon and the Balearic Islands. It is also spoken in Andorra, Rosselló and L'Alguer. Catalan has two major dialectal regions: Eastern, which comprises the Eastern dialects: Central Catalan (with *Barceloní* among others), *Balearic*, *Rossellonès*, and *Alguerès*; and Western, which contains North-western (with *Lleidatà* among others) and Valencian dialects. (See map 1).

The fundamental vocalic differences between these two diasystems are based on their unstressed vowel system and on a few consonant features [9]. As for their stressed vowel system, traditionally, the description considering Catalan dialects has been based on auditive observations made from utterances obtained by linguists in several territories of the language domain ([1], [6], [9]). Some of the studies that deal with the description of Catalan dialects took place at the beginning of the 20th century and also in later dates, these including acoustic data, as in: [2], [3], [5], [7] [8] & [4].

It has been proved that auditive impressions traditionally used by phoneticians do not reach as high a degree of precision and concretion as that offered by experimental instruments. However, there is little research on the contrast of Catalan dialectal phonetic features using these instruments. The study [7] is an exception to this as it presents acoustic differences between north-western, central, Majorcan and Valencian Catalan in vowels [ɛ], [ɔ] and [a].

The aim of this paper is to present an initial contribution to the lack of literature on the description of vowels proper of different Catalan dialects from an experimental and contrastive approach. It describes de differences in quality of the vowels [e], [ɛ], [o] and [ɔ] in *barceloní, lleidatà, mallorquí* and *southern valencià* (the dialects spoken in Barcelona, Lleida, Majorca and Southern Valencian Country, respectively) through the analysis of F1 and F2 of these sounds in a consonant context of [p]. (See map 1.).

Map 1. Catalan dialects studied (Western dialects on the left; Eastern dialects on the right)

2. Methodology

The data have been obtained from the analysis of laboratory speech recorded in optimal conditions. In this initial study, twelve men were registered (three for each dialectal variant), they were aged 22 to 30 and their pronunciation did not show any influence of Spanish or any other language.

Speakers come from four specific geographical areas: Barcelonès, Segrià, Western Majorca, and La Safor. In this way, the study reflects Eastern Catalan speakers (from the Barcelona area and Palma de Mallorca) and Western Catalan speakers (from the Lleida area and Gandia –Valencia-). From another point of view, the study takes speakers representative of constitutive dialects (those from Barcelona and Lleida) and consecutive dialects (those from València and Palma de Mallorca), in such a way that the four surveyed localities can reflect the speech of the main dialects of the Catalan language territory, still incomplete.

This study focuses on mid vowels, both from the front set, [e] [ɛ], and from the back set, [o] [ɔ]. All of them were uttered in symmetric CVC sequences. The consonant used for the context was the voiceless bilabial plosive [p]. The possible sound combinations were placed in the following sentence: *"diu CVC quan vol"* ('s/he says CVC when s/he wants'). Each speaker read the sequences three times, which determined a final corpus of 144 vowels.

The acoustic analysis carried out were F1 and F2 frequency measuring at the most static period of each vowel, through the LPC technique. F3 frequencies have not shed light in determining dialectal vowel distinction in the previous analysis. CSL4300B by KAY Elemetrics Corp. was

the analyser used at the Phonetics Laboratory of the University of Barcelona. Afterwards, statistic analysis was taken from the data obtained through the statistic software SPSS 10.6.4 running a One Way ANOVA, post hoc Scheffé. Factors were vowel quality and dialect. Contrast significance was established at $p<0,05$.

3. Results

The results obtained from the aforesaid acoustic measures are now exposed for each of the formants, F1 and F2, the most relevant ones in Catalan vowel quality description In particular, we present an explanation for the front vowel set and another explanation for the back vowel set.

In each section there are three focuses of interest and, therefore, we expose the results, which, through statistic procedures, we analysed: a) in which cases the data show significant differences according to dialect and vowel quality; b) in which cases the data show significant differences according to dialect for each vowel set; c) in which cases the data show significant differences according to quality in each dialect.

The mean values in each parameter, according to vowel quality and sub-dialect appear in table 1 and graph 1. These graphs clearly point to the fact that, within front vowels, [ɛ] presents a higher F1 than [e] and a lower F2 than [e] in all the dialects studied, which indicates that [ɛ] is always more open than [e], as expected. As far as back vowels are concerned, the difference is clear and expected for F1. However this difference is not so clear for F2, contrary both to our expectations and to what [7] observes.

Table 1: Mean F1 and F2 values of mid vowels between the voiceless bilabial plosive [p] for each sub- dialect studied

VOWEL QUALITY	SUBDIAL.	F1 $\bar{x}$ (s)	F2 $\bar{x}$ (s)
[ɛ]	Barceloní	554 (25,17)	1718 (36,84)
	Lleidatà	606 (23,61)	1674 (129,36)
	Southern valencià	718 (55,63)	1705 (120,34)
	Mallorquí	711 (66,08)	1647 (59,95)
[e]	Barceloní	401 (29,92)	1899 (87,73)
	Lleidatà	434 (27,88)	1830 (109,45)
	Southern valencià	611 (31,22)	1764 (165,45)
	Mallorquí	565 (51,56)	1755 (68,01)
[ɔ]	Barceloní	491 (42,23)	920 (100,47)
	Lleidatà	543 (47,32)	948 (78,76)
	Southern valencià	677 (59,93)	1223 (41,35)
	Mallorquí	699 (34,11)	1167 (59,26)
[o]	Barceloní	401 (25,61)	852 (70,27)
	Lleidatà	439 (23,03)	952 (79,27)
	Southern valencià	565 (36,74)	1125 (51,65)
	Mallorquí	581 (34,68)	1071 (39,04)

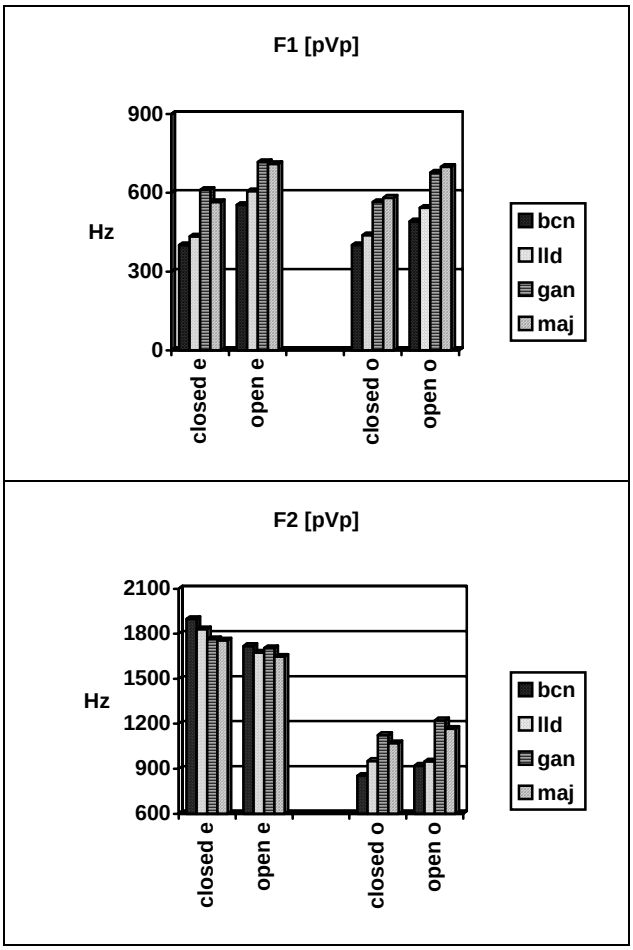

Figure 1: F1 and F2 values of mid vowels for each sub-dialect studied

3.1. Front vowels F1

There are significant differences in the open vowel within the samples taken from *barceloní* and *lleidatà*, on the one hand, and within those taken from southern *valencià* and *mallorquí*, on the other. However, there are not such differences among the vowels of *barceloní* and *lleidatà*, or among the vowels of southern *valencià* and *mallorquí*. This is the same for the close vowel.

Considering the front set globally, there are F1 values which are very similar among dialects so we do not find any significant differences among F1 frequencies of: 1) [ɛ] of *barceloní* and [e] of southern *valencià* or *mallorquí*; 2) [ɛ] of *lleidatà* and [e] of southern *valencià* or *mallorquí*. Certainly, F1 values are very similar (see table1): 554 Hz. ([ɛ] of *barceloní*), 606 Hz. ([ɛ] of *lleidatà*), 611 Hz. ([e] of southern *valencià*) and 565 Hz. ([e] of *mallorquí*). The most similar values are those of Barcelona and Majorca, on the one hand, and those of Lleida-València, on the other. These results can be grouped dialectally (eastern Catalan, on the one hand, and western Catalan, on the other).

Furthermore, each dialect shows significant differences in F1 between the quality of their open vowel and the quality of their close vowel. This fact, added to the lack of significant difference observed for F2 at this point (see section 3.2),

makes us state that, according to our data, F1 is more relevant than F2 in the distinction of front mid vowel quality in a voiceless bilabial plosive context.

3.2. Front vowels F2

In the post hoc contrasts applied after the OneWay ANOVA test, regarding dialect contrasts in a particular quality, Scheffé shows that F2 of [e] and [ɛ] do not bear any significant differences among dialects. That is, there is no difference in e] between each pair of sub-dialects in all the possible combinations, and this is the same for [ɛ].

Besides, considering the whole front vowel set ([e] and [ɛ]) we can observe that F2 in the close vowel of *barceloní* (1899 Hz) presents significant differences as compared to the open vowel of the rest of sub-dialects ($p<0,05$) (with values ranging from 1647 Hz and 1705 Hz.) but we do not find them in the other contrasts carried out. Therefore, we can say that there are no significant differences among [e] of *lleidatà*, that of southern *valencià* or that of *mallorquí* and [ɛ] of the other sub-dialects.

There is another outstanding fact in these contrasts: no dialect bears significant F2 differences between their vowels [e] and [ɛ]. In other words, although the real values show (as can be seen in the means of table 1 and graph 1) that F2 frequencies of close vowels are higher, closer, than that of open ones, this difference is not relevant enough to be significant; we do not find, statistically, differences between the value of [e] and [ɛ] within each sub-dialect. The clearest case is that of southern *valencià*, which presents values of F2 at 1705 Hz for the open vowel and at 1764 Hz for the close one. This remark, contrary to expectations, seems to point that probably the F2 parameter is not the most relevant for distinguishing these vowels quality.

3.3. Back vowels F1

Among the F1 values of both open and close back vowels we want to point out that there are significant differences among vowels of *barceloní* and *lleidatà*, on the one hand, and among southern *valencià* and *mallorquí*, on the other. However, as we indicated in the previous vowel set, there are no such differences within each dialectal group.

Taking into account the whole back vowel set, we can see that there are no statistically significant differences among F1 of: 1) [o] of southern *valencià* or *mallorquí* and [ɔ] of *barceloní* or *lleidatà*; 2) [o] of *lleidatà* and [ɔ] of *barceloní*.

Except for the latter, we noticed that the values of [o] of the consecutive dialect group (represented here by Gandia and Majorca) are very similar to those of [ɔ] of the constitutive dialect group (Lleida and Barcelona in this case). Actually, if we check table 1 we can observe, for instance, the following F1 values: 565 Hz for [o] of southern *valencià* and 543 Hz for [ɔ] of *lleidatà*.

As for intradialectal vowel quality consideration, we can find some differences among F1 of [o] and [ɔ] of *lleidatà*, southern *valencià* and *mallorquí*, but not in *barceloní* (491 Hz, 401 Hz, for the close vowel and for the open vowel respectively). In this sub-dialect, F1 and F2 combination has to be the way for distinguishing vowel quality among these vowels.

3.4. Back vowels F2

F2 values for [ɔ] show significant differences among the samples of southern *valencià* and *mallorquí*, on the one hand, and those of *barceloní*, on the other, which also happens among vowels of southern *valencià* and those of *lleidatà*. For the close vowel, it is only the contrast among samples of southern *valencià* and those of *barceloní* that turns out to be statistically relevant. There are no cases of differences among vowels of *valencià* and *mallorquí* or among those of *barceloní* and *lleidatà*.

Open and close qualities taken as a whole do not show statistically significant differences in the following samples: 1) [ɔ] of *barceloní* and [o] of *lleidatà* and *mallorquí*; 2) [ɔ] of *lleidatà* and [o] of southern *valencià* and *mallorquí*; and finally, 3) [ɔ] of southern *valencià* and [o] of *mallorquí*. This *status quo* allows us to state that some subdialects present some close vowels as open as the open vowels of other sub-dialects. In general, close vowels of *valencià* and *mallorquí* are more similar to open vowels of *barceloní* and *lleidatà* than to their close vowels.

As for the difference in F2 values among open and close vowels within each dialect, there is no significant difference. That is, in *lleidatà* the difference between [o] and [ɔ] is not significant (a mean of 948 Hz for the open vowel, 952 Hz for the close one), accordingly to what happens for the rest of sub-dialects studied here. This phenomenon is the same as the one we saw for front vowels and it reinforces the conception of the low relevance of F2 as far as intradialectal vowel quality distinction is concerned.

4. Discussion

The general tendency clearly shows, both in the front set and in the back set, that F1 values for *mallorquí* and *valencià* are higher than those of *barceloní* and *lleidatà*, which always imply a higher degree of openness. The graphs illustrate two large groups, the first one being formed by the geographically closest dialects (*barceloní* and *lleidatà*), the second one, by the most peripheral dialects (*valencià* and *mallorquí*). These two groups are not easily distinguishable internally.

For F2, this tendency is not so clear and it is shown only in the back vowel set. (See also []). In front vowels we can only see that *barceloní* offers higher values that the rest of dialects. Probably, the standard deviations found in F2 (larger that those found for F1) diminished the relevance of this parameter.

From these values we can deduce that mid vowel qualities of consecutive dialects are more open than those of constitutive dialects. Our data coincide, in a generic way, with the previous auditive studies on vowel openness in four different dialectal locations: certainly, [1] states that the four vowels are closer in *barceloní* and *lleidatà* than in *valencià* and *mallorquí*.

As for the acoustic parameters, [6] points out the frequency relevance of F1 and F2 in the acoustic feature of [ɛ], which does not coincide with our results. Furthermore, it also presents an interdialectal grouping of the acoustic realisation of these vowels that stays far from our results, as it

establishes the following dialectal groups according to similar vowel realisations: 1) *mallorquí, lleidatà* and *valencià*, on the one hand; and 2) central Catalan, on the other.

5. Conclusion

The first conclusion to be drawn from the present study is the fact that the four dialects, which represent four main and extreme dialectal locations, offer clearly different values concerning mid vowels.

Our results show a gradation of general openness for each vowel when they are in a [p] context:

[e]: barceloní < lleidatà < mallorquí < valencià

[ɛ]: barceloní < lleidatà < valencià < mallorquí

[o]: barceloní < lleidatà < mallorquí < valencià

[ɔ]: barceloní < lleidatà < mallorquí < valencià

However, something has to be clarified about this gradation: vowels of *barceloní* and *lleidatà* are not always easily distinguishable, and so are those of *valencià* and *mallorquí*. The clear fact, this being the third conclusion, is that vowels of peripheral dialects (*mallorquí* and *valencià*) are much more open than those of the central group. Statistics asserts these remarks.

As a summary, we can see these differences in the following simplified spectrograms (see figure 2)

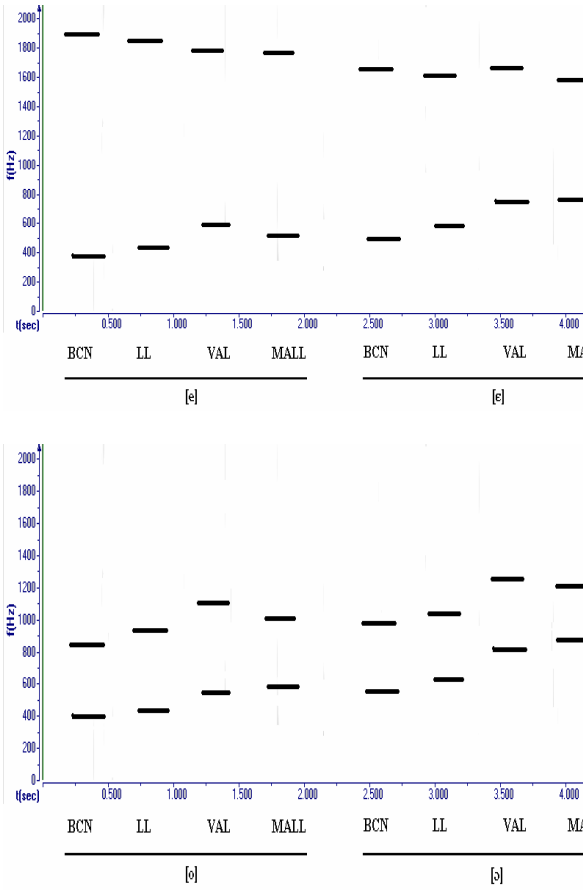

Figure 2: Simplified spectrograms of mid vowels.

As the data show, it seems more relevant, regarding the openness of mid vowels, that the grouping of the sub-dialects studied should be done taking into account the constitutive-consecutive dialect feature rather than that of western-eastern used for other phonic parameters.

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