



20th IFOS World Congress
June 1-5, 2013 Seoul, Korea



FUNDAÇÃO
CALOUSTE
GULBENKIAN



FADO

VOCAL ACOUSTIC CHARACTERIZATION

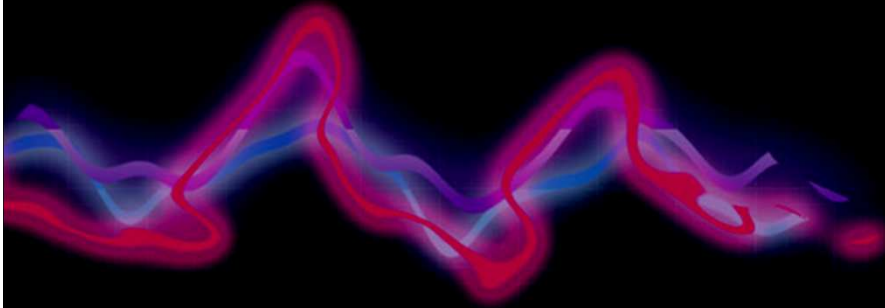
Ana P. Mendes, Ph.D

Aira Rodrigues | David Guerreiro



FR-01433

PA - Singing Voice Disorder



Amália Rodrigues
“Tudo isto é Fado”

Fado is a Portuguese musical style and Intangible Heritage of Humanity by UNESCO.

FADO

Singers – Elite voice professionals

Goal → excellent *performance*

Speech-Language Pathologist

Therapeutic intervention in spoken voice

Adaptation of rehab techniques

base → singers' vocal acoustic
and physiology

**Vocal rehabilitation and
optimization**

Objective monitoring with acoustical
analysis

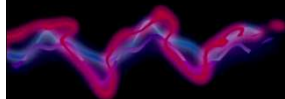
Classical Western
Country
Jazz
Pop
Soul
Broadway/ musical theatre

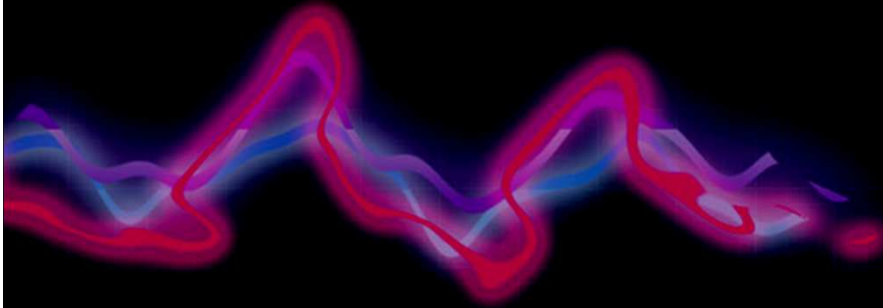


Singing styles
Research & Knowledge



Fado



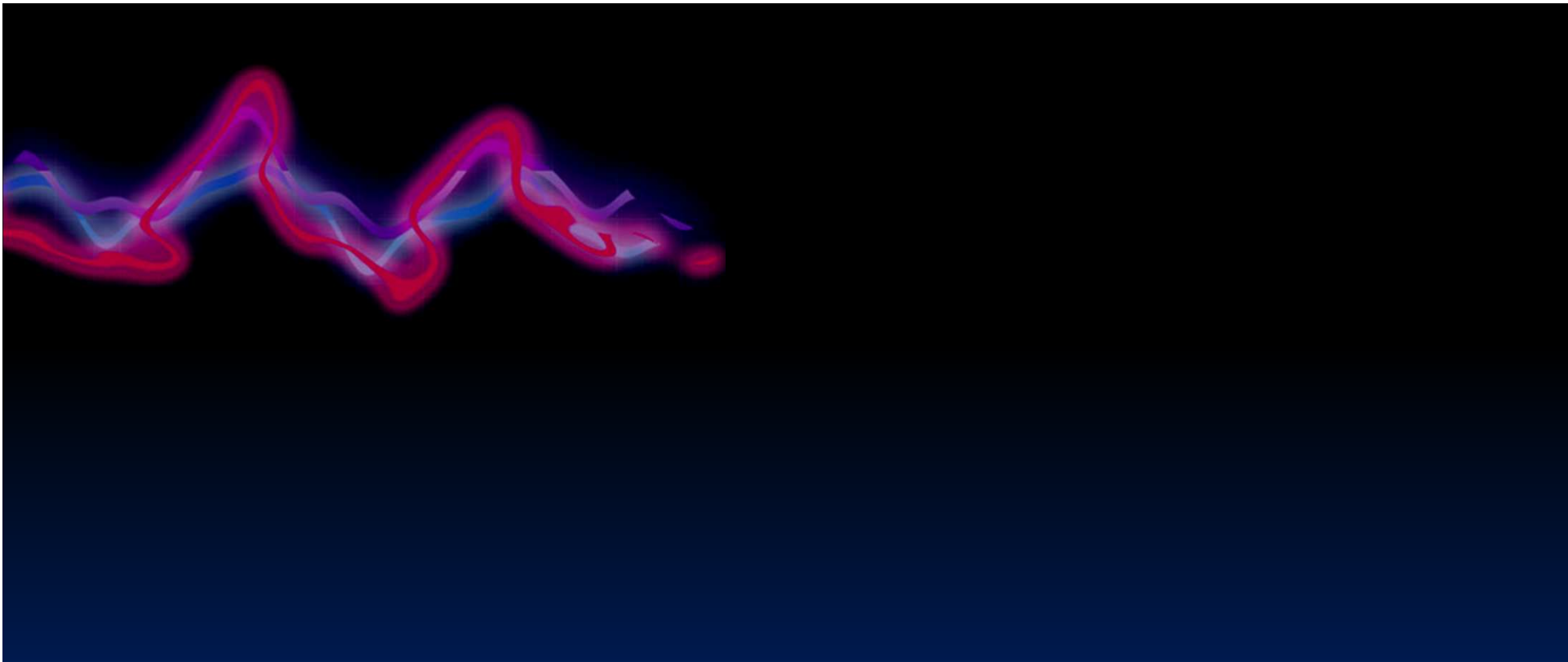


The results allowed to sketch the acoustic and phonatory profile of the Fado singers' voice

Mendes A., Rodrigues A. & Guerreiro D. Acoustic and Phonatory Characterization of the Fado Voice. *Journal of Voice*.
(in press, accepted in October 2012)

FADO

PILOT-STUDY (2010)

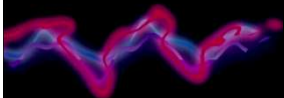


METHODS

SUBJECTS

N = 15

	M (n=10)	F (n=5)
Age mean \pm SD	44 \pm 15	46 \pm 17
Professional experience	Professional	1
	Amateur	3
Habits	Drinking	2
	Smoking	2



SUBJECTS' CHARACTERIZATION

Physical Condition

- Reasonable / Good

Drinking and Smoking Habits

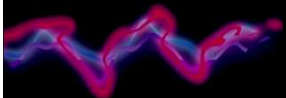
- Frequent

Musical/Singing Education

- Occasional / None

Monitoring by an ENT

- Rare/ None



PROCEDURES

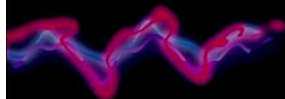
Informed consent form

Vocal health and background questionnaire

Phonatory tasks

Recording equipment

Acoustic and statistical analysis



PROCEDURES

Data collecting



RPP Audiovisual
Studio(Seixal)



Recording room
(Noise environment < 50dB)

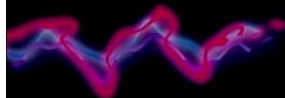
Data analysis



Voice Lab, ESS-IPS

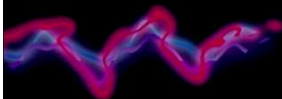


MDVP Advanced;
Multi-Speech; Singing Studio;
SPSS

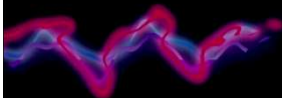


TASKS & MEASURES

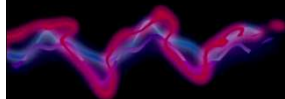
	Phonatory task	Acoustic measures
Spoken voice	Sustaining [a]	MPT
	Sustaining [s, z]	s/z ratio
	Sustaining [a, i, u]	F ₀ , jitter, shimmer, HNR
	Reading aloud text – <i>O Sol</i> (phonetically balanced text)	F ₀
Sung voice	Sustaining [a, i, u]	F ₀ , jitter, shimmer, HNR
	Sustaining [a] lowest modal < highest falsetto	MPFR (F ₀)
	Singing Fado	Vibrato
	Sustaining [a, i, u] – <i>Happy Birthday</i>	Singer's formant

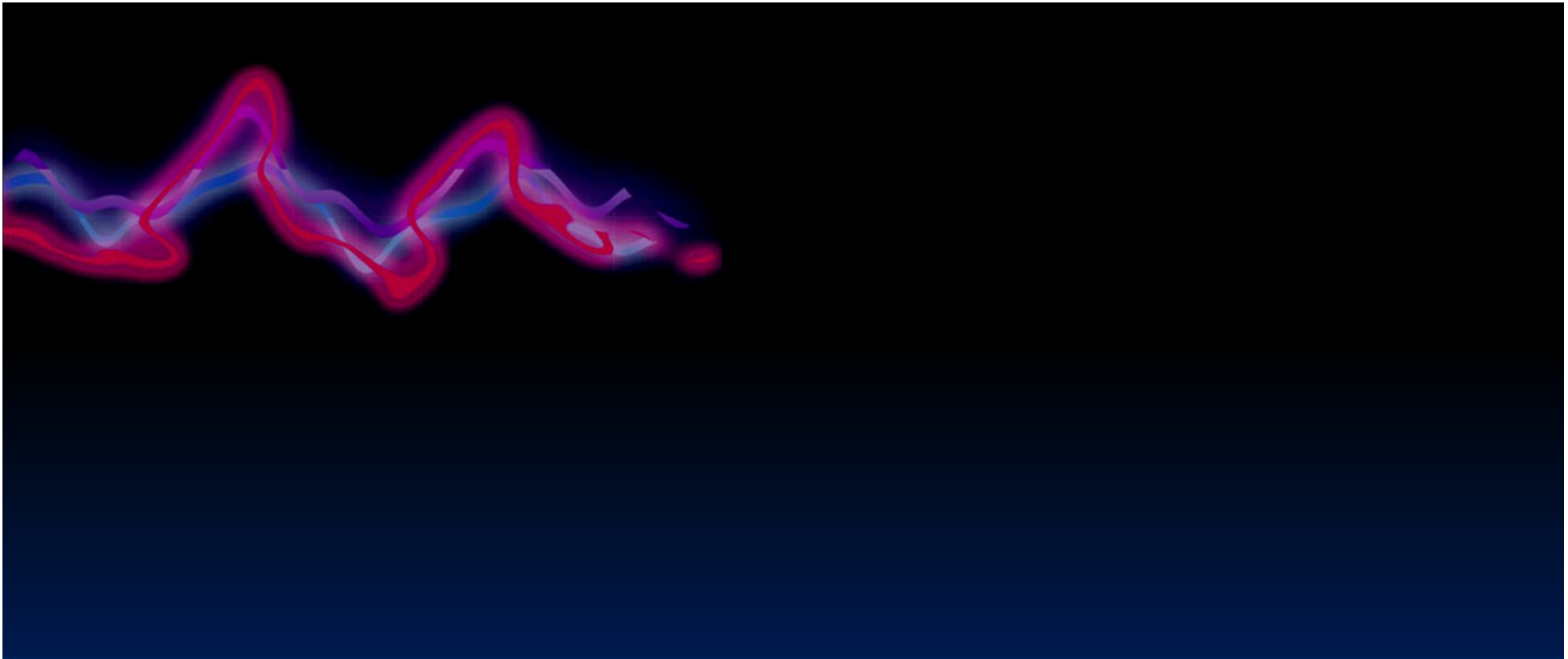


RECORDING EQUIPMENT



ANALYSIS EQUIPMENT





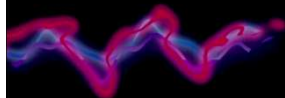
RESULTS

TEMPORAL MEASURES

	N	Gender	FADO singers	Non-singers (Colton & Casper, 1996)
			Mean \pm SD	
/a/ MPT	10	M	21,81 \pm 6,02	20
	5	F	11,72 \pm 1,60	15
s/z ratio	10	M	1,14 \pm 0,41	< 1,2
	5	F	1,26 \pm 0,15	

Temporal measures \approx pathological threshold

- MPT
- s/z ratio



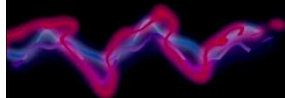
SPECTRAL MEASURES

Spoken voice, reading aloud

N	Gender	F ₀ (Hz)	Rate F ₀ (Hz)	
		Mean ± SD	Min	Max
10	M	141,44 ± 24,56	98,13	175,33
5	F	205,88 ± 9,28	192,95	218,36

FADO ≠ non-singers and Classical western

- non-singers < **Fado F₀**
- Classical western (M) < **Fado F₀** = Classical western (F)



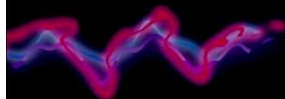
SPECTRAL MEASURES

Spoken voice, sustaining [a,i,u]

N	Gender	Vowel	Mean \pm SD			
			F ₀ (Hz)	Jitter (%)	Shimmer (%)	HNR
10	M	[a]	172,22 \pm 39,55	0,63 \pm 0,32	2,14 \pm 0,80	0,12 \pm 0,04
		[i]	182,18 \pm 35,63	0,52 \pm 0,47	1,35 \pm 0,29	0,11 \pm 0,03
		[u]	181,51 \pm 37,88	0,91 \pm 0,78	1,10 \pm 0,44	0,09 \pm 0,04
5	F	[a]	251,32 \pm 57,02	0,91 \pm 0,48	2,87 \pm 0,33	0,11 \pm 0,02
		[i]	254,89 \pm 51,30	1,16 \pm 0,73	2,28 \pm 0,69	0,10 \pm 0,03
		[u]	269,65 \pm 55,58	0,75 \pm 0,17	1,14 \pm 0,59	0,10 \pm 0,03

FADO \neq non-singers and Classical western

- non-singers < **Fado F₀**
- Classical western (M) < **Fado F₀** = Classical western (F)
- non-singers < **Fado Jitter Shimmer** (\approx pathological threshold)
- **Fado HNR** = non-singers



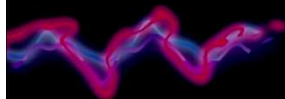
SPECTRAL MEASURES

Singing voice, sustaining [a,i,u]

N	Gender	Vowel	Mean \pm SD			
			F ₀ (Hz)	Jitter (%)	Shimmer (%)	HNR
10	M	[a]	166,26 \pm 27,44	0,44 \pm 0,18	1,98 \pm 0,51	0,14 \pm 0,03
		[i]	199,44 \pm 33,54	0,74 \pm 0,50	1,68 \pm 0,55	0,11 \pm 0,04
		[u]	199,33 \pm 32,99	0,68 \pm 0,38	0,95 \pm 0,21	0,10 \pm 0,02
5	F	[a]	245,76 \pm 21,45	0,44 \pm 0,20	2,56 \pm 1,00	0,14 \pm 0,01
		[i]	294,08 \pm 30,75	0,81 \pm 0,32	2,28 \pm 0,45	0,12 \pm 0,02
		[u]	298,41 \pm 34,01	0,46 \pm 0,20	1,88 \pm 1,34	0,09 \pm 0,03

FADO \neq other singing styles

- Jazz, country, soul, Broadway, Classical western < **Fado Jitter** < pop
- Classical western < **Fado Shimmer** < pop, jazz, country, soul, Broadway
- **Fado HNR** = Classical western



Maximum Phonation Frequency Range

Sustaining [a] lowest modal - highest falsetto

	N	Gender	F ₀ (Hz)	Rate F ₀ (Hz)	
			Mean ± SD	Min	Max
Minimum	10	M	102,95 ±14,89	87,49	140,50
	5	F	175,66 ±22,89	149,63	199,83
Maximum	10	M	425,77 ±102,55	312,83	592,21
	5	F	466,05 ±109,80	357,42	637,63

FADO comparing to Classical Western

- MPFR ≈ baritones (M) and mezzo-sopranos (F)



VIBRATO

Sustained vowel in Fado song

N = 11



N	Gender	Vibrato Frequency (Hz)			Vibrato Extension (ST)		
		Mean \pm SD	Min	Max	Mean \pm SD	Min	Max
8	M	5,72 \pm 0,72	4,55	6,67	2,39 \pm 0,75	0,75	3,69
3	F	5,73 \pm 0,92	5,06	6,78	2,61 \pm 0,91	1,58	3,32

Classical western singers: [6,28Hz - 7,14Hz]

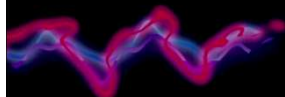
(Callaghan et al., 2004)

Freq._{vibrato} > 4 Hz || Ext._{vibrato} = 0,38 – 3,26 ST

(Bezerra et al., 2009; Dejonckere et al., 1995)

Freq._{tremor} = 3-5 Hz

(Colton & Casper, 1996)

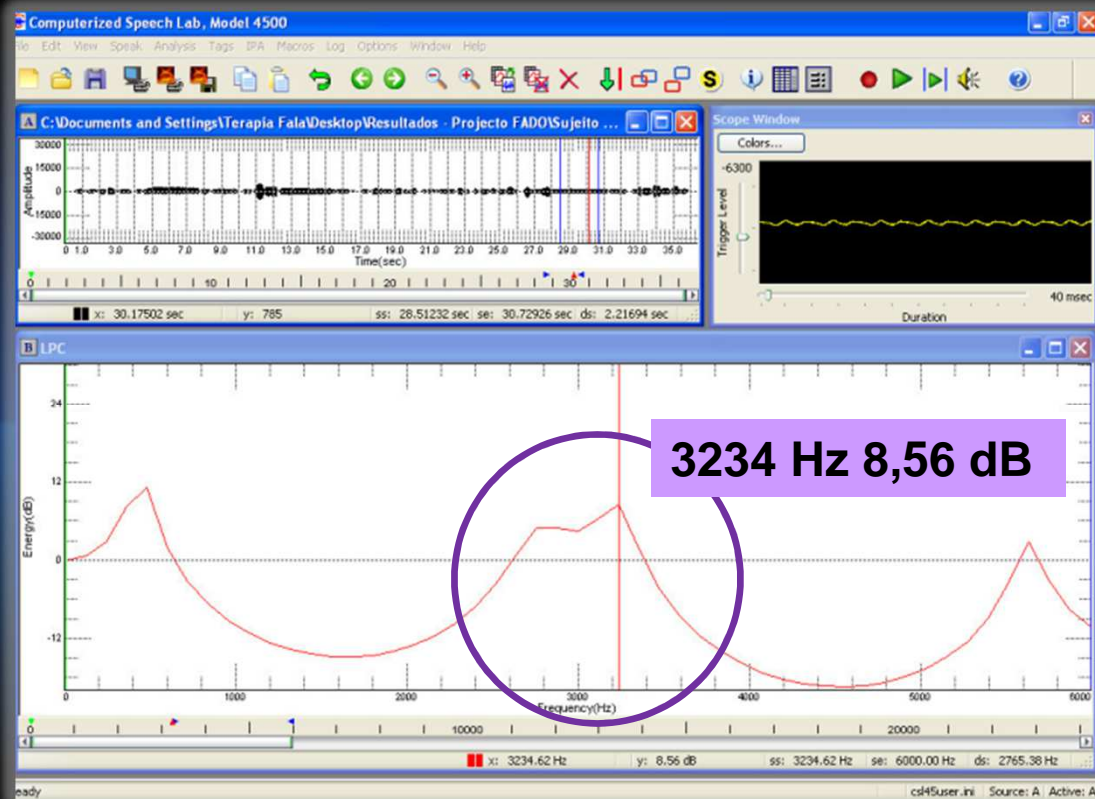


SINGER'S FORMANT

N = 1

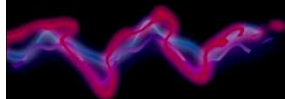
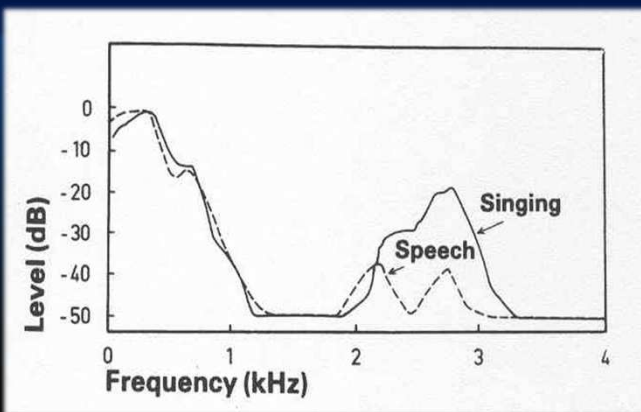
N	/a/		/i/		/u/	
	F (Hz)	Amp. var. (dB)	F (Hz)	Amp. var. (dB)	F (Hz)	Amp. var. (dB)
1					3363,50	0,94
2					3323,46	0,90
3	2983,11	1,59			2903,02	5,20*
4	3183,32	1,22	3223,36	8,45	3163,30	3,37*
5	3303,44	0,92				
6	3363,50	0,93	3183,32	9,43	2983,11	0,89

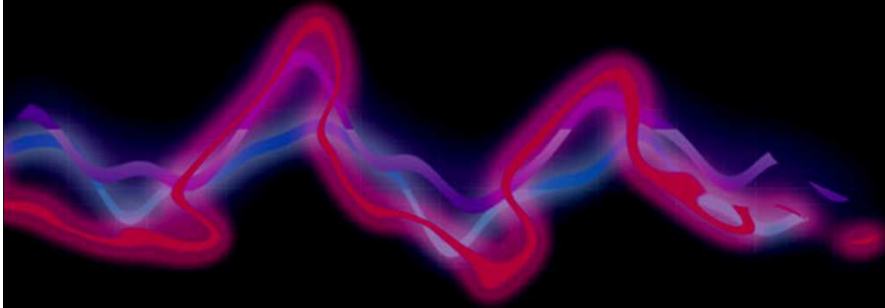
SINGER'S FORMANT



Classical western singers

- 2800 Hz - 3500 Hz
- F3 e F4 vowels
- Variation = 3 - 5 dB





FUNDAÇÃO
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ieeta



IPS
Instituto
Politécnico de Setúbal
Escola Superior de
Saúde

Approved and financed by Calouste
Goulbenkian Foundation
2013

Fado

FUTURE RESEARCH

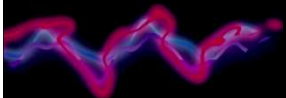
FUTURE RESEARCH

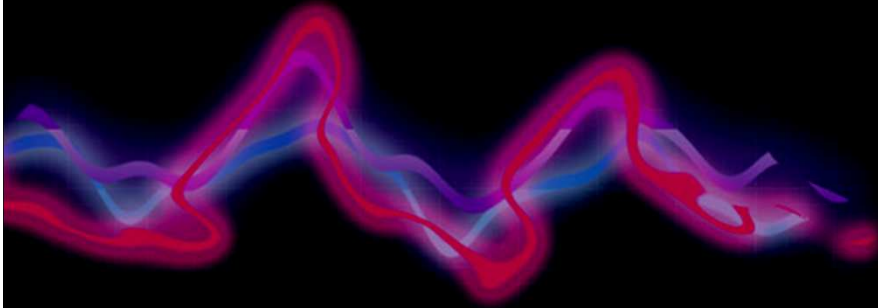
The goal is to maintain and/or improve FADO singers' vocal quality based on a vocal acoustic standard reference.

384 subjects will be recorded in 12 months:

- to have a representative sample size;
- to generalize and/or extrapolate the voice acoustic data.

This will help professionals that work with Fado spoken and/or sung voice in clinical, pedagogic or research settings.





Ana P. Mendes

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THANK YOU!



Ana Moura
"DesFado"

