University of the Basque Country
University of Las Palmas de Gran Canaria

Emotion Recognition oriented to early diagnosis of dementias

K. Lopez-de-Ipiña, J.B. Alonso

Brno 2012

Outline

- Alzheimer Disease (AD)
- Diagnosis of AD
- New approach
- Methods
- Experimentation
- Concluding Remarks

Alzheimer

Alzheimer's disease (AD) is the most common type of dementia and it has been pointed out that early detection and diagnosis may confer several benefits.

Alzheimer Disease

- Progressive and irreversible deterioration of higher brain functions or cognition
- Loss of memory, judgment and language,
- AD prevents the execution of daily life tasks
- Giving rise to severe disability towards a full dependence

Diagnosis of AD

- After the loss of memory, one of the major problems of AD is the language. The loss of ability to express with language will affect two types or two aspects:
  - difficulty to speak
  - difficulty to understand
- Communication déficits:
  - Aphasia: difficulty in speaking and understanding
  - Anomia: difficulty for recognizing and naming things.

Communication Problems

•The problems in communicating according to the stage of the disease:

- **First Stage:** Difficulty for finding the right word in the spontaneous speech. Often it is not detected.
- **Second Phase:** impoverishment of language and vocabulary for everyday use.
- **Third stage:** Answers sometimes are very limited and with very few words.

Emotional Respose through different stage

- In **early stages:**
  - Social disinhibition, behavioural changes (be angry and not being able to perform common tasks, not to express or not remembering)
  - Crying more easily to be aware that caregivers of stroke
  - Gratefully acknowledge the caresses, smiles and hugs.
  - Reacts aggressive on things that, for healthy people, are harmless.
  - Perceives a threat or danger where does not exist.
  - Depression

Emotional Respose through different stage

- In **advanced stages**:
  - May seem shy and apathetic, attributed to memory problems or difficulty for finding the right words.
  - Some responses are magnified due to an alteration in perception.
  - Other research suggests, may also have a reduced ability to feel emotions due to loss of memory and memories.
  - Then it appears apathy
  - Sometimes depression.

Outline

- Alzheimer Disease (AD)
- Diagnosis of AD
- New approach
- Methods
- Experimentation
- Concluding Remarks

Diagnosis of AD

- An early and accurate diagnosis of AD could helps patients and their families
  - To plan for the future and offers the best opportunity
  - to treat the symptoms of the disease.
- Currently diagnosis is make
  - by exclusion of other dementias
  - making a post-mortem brain tissue analysis.
- The diagnosis of AD three distinctions are being used: possible, probable and definite .

Diagnosis of AD

- Eight cognitive domains are most often damaged in AD (Morris,1993;American Psychiatric Association):
  - memory
  - language
  - perception
  - attention
  - constructional skills
  - counselling skills
  - problem solving
  - functional capabilities

Diagnosis of AD

- The clinical diagnosis is usually based on:
  - Tests of memory and other cognitive functions
  - Behavioural changes analysis
  - Neuroimaging (CT, SPECT, PET, fMRI)
  - The absence of other causes by other medical tests
  - Comparing with other diseases
- The greater the number of tests used in the detection, the higher the reliability of the diagnosis.

Outline

- Alzheimer Disease (AD)
- Diagnosis of AD
- New approach
- Methods
- Experimentation
- Concluding Remarks

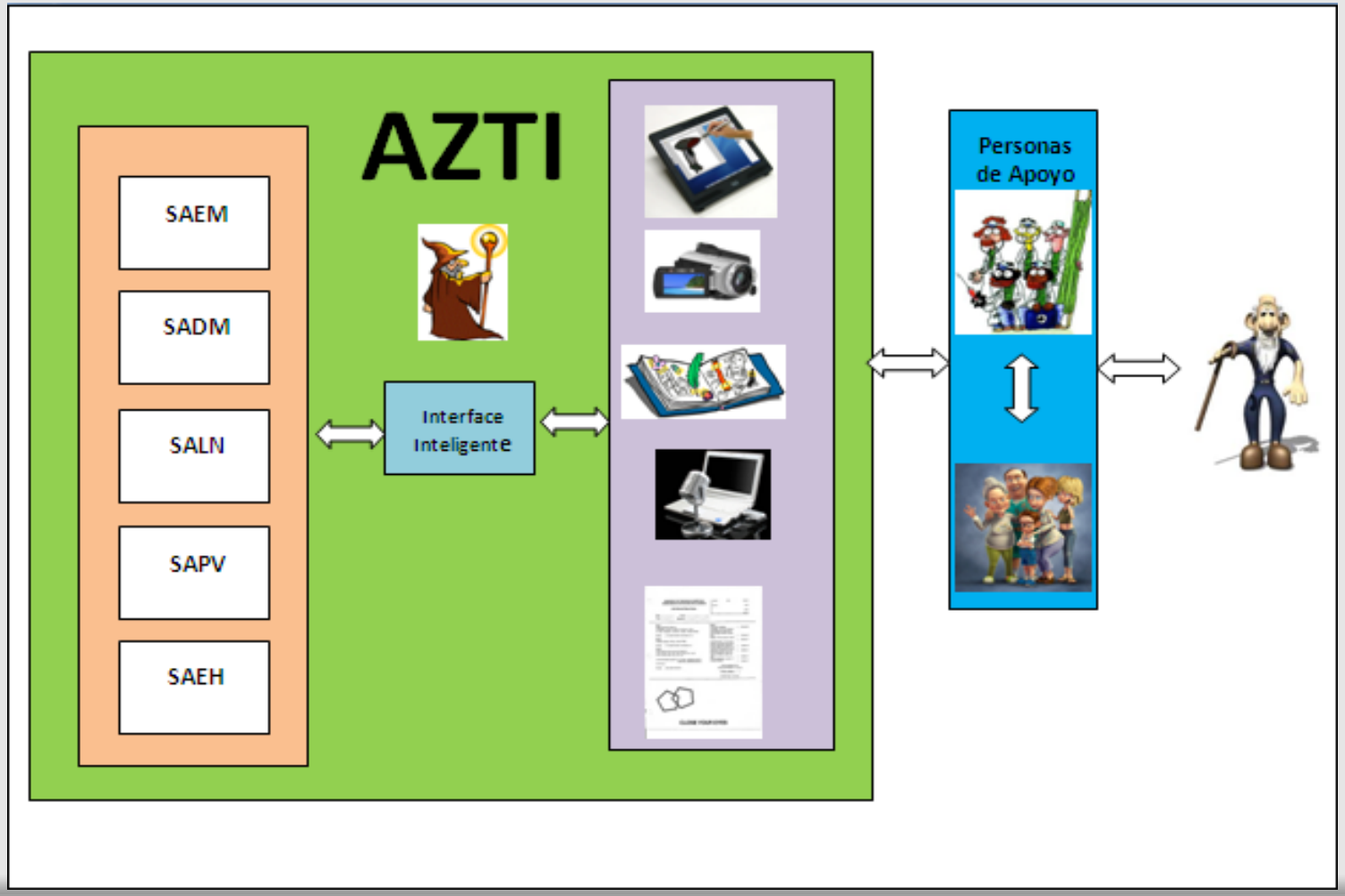
New approach

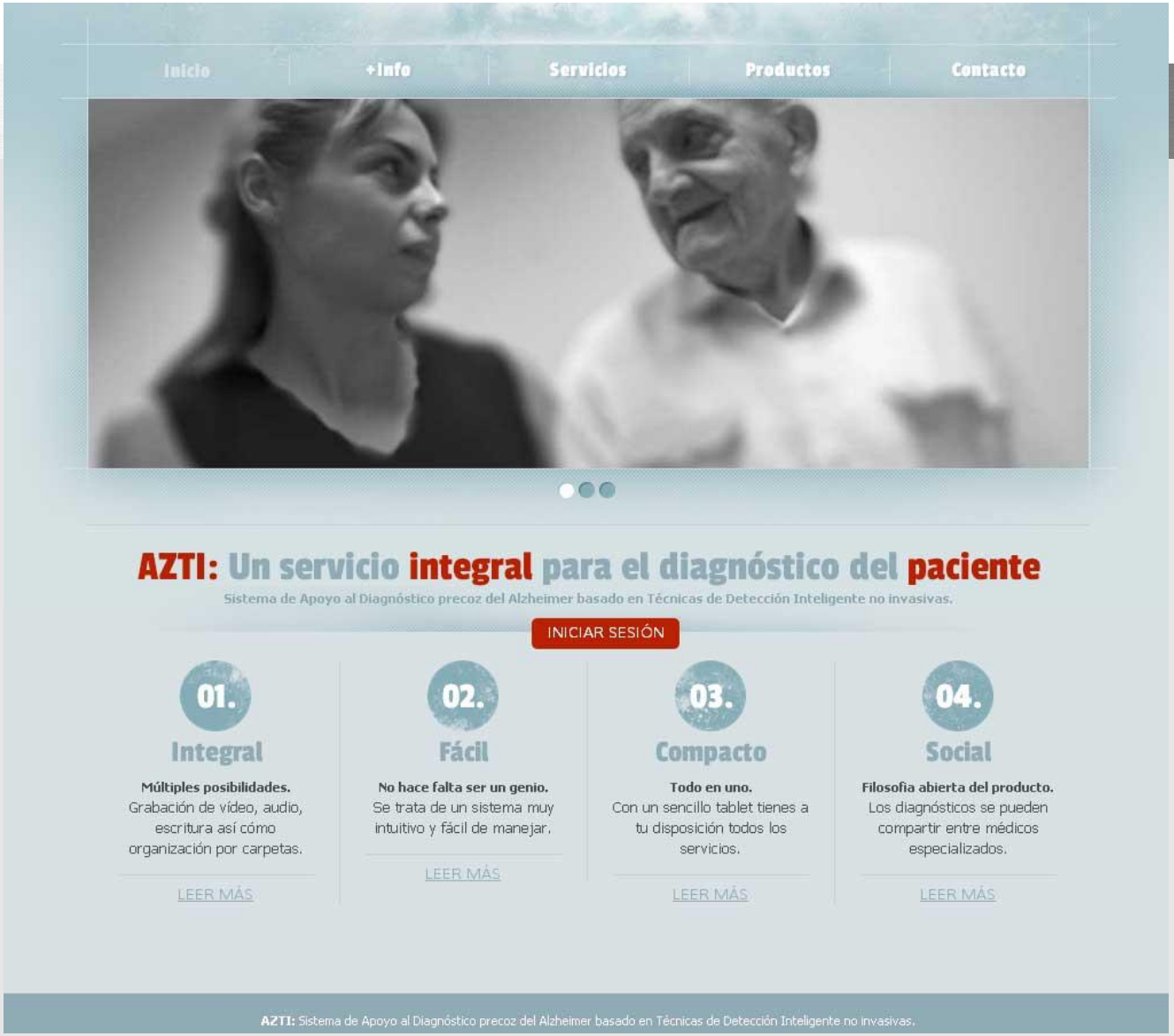
- Non-invasive Intelligent Techniques of diagnosis
- Early detection of dementia
- Non-technologists in the habitual environments of the patient
- Without altering or blocking their abilities.

New approach

- Based on
  - Handwiting and Drawing Analysis
  - Speech Recognition
  - Emotion Analysis
  - Face Recognition
  - GAP Recognition

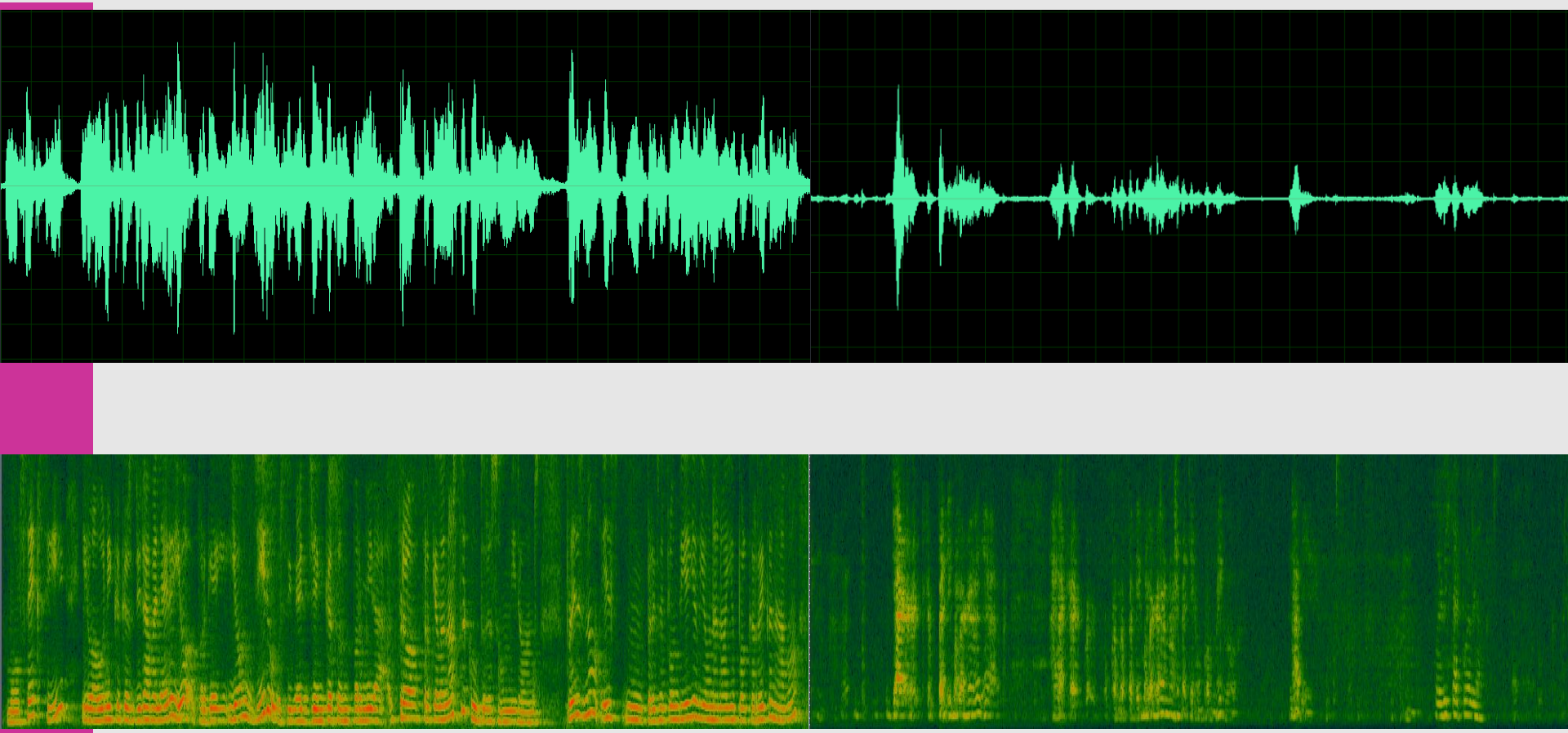
New approach



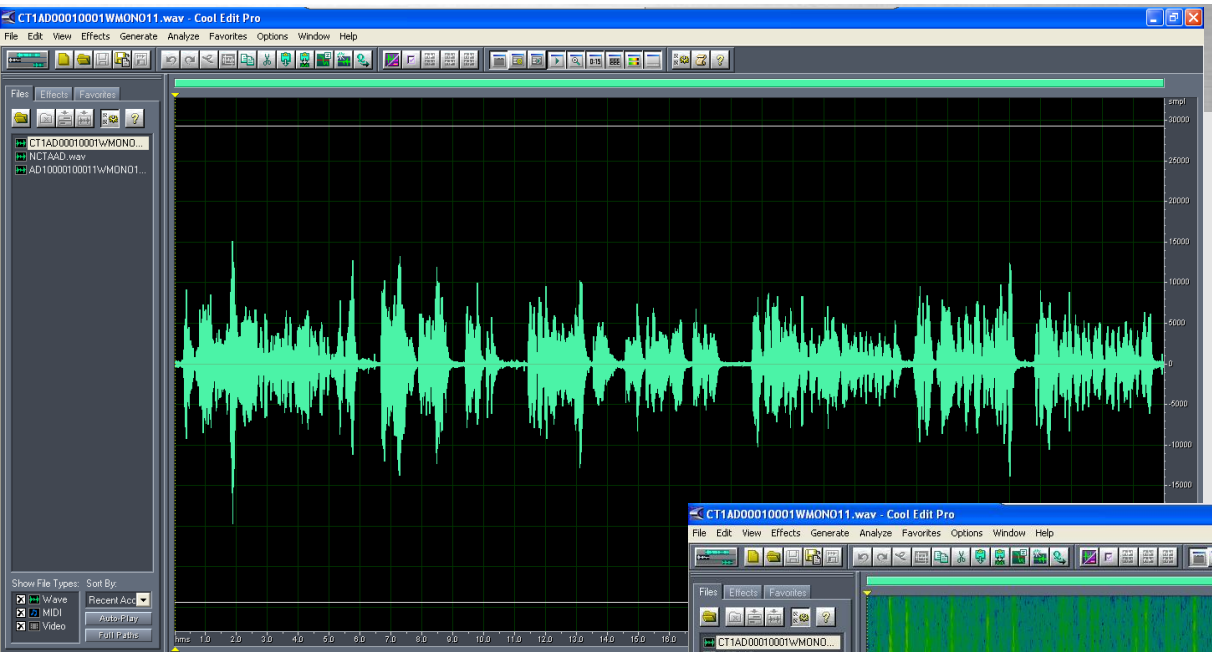

Inicio
+Info
Servicios
Productos
Contacto
AZTI: Un servicio integral para el diagnóstico del paciente
Sistema de Apoyo al Diagnóstico precoz del Alzheimer basado en Técnicas de Detección Inteligente no invasivas.
INICIAR SESIÓN
01.
Integral
Múltiples posibilidades.
Grabación de vídeo, audio, escritura así cómo organización por carpetas.
LEER MÁS
02.
Fácil
No hace falta ser un genio.
Se trata de un sistema muy intuitivo y fácil de manejar.
LEER MÁS
03.
Compacto
Todo en uno.
Con un sencillo tablet tienes a tu disposición todos los servicios.
LEER MÁS
04.
Social
Filosofía abierta del producto.
Los diagnósticos se pueden compartir entre médicos especializados.
LEER MÁS
AZTI: Sistema de Apoyo al Diagnóstico precoz del Alzheimer basado en Técnicas de Detección Inteligente no invasivas.

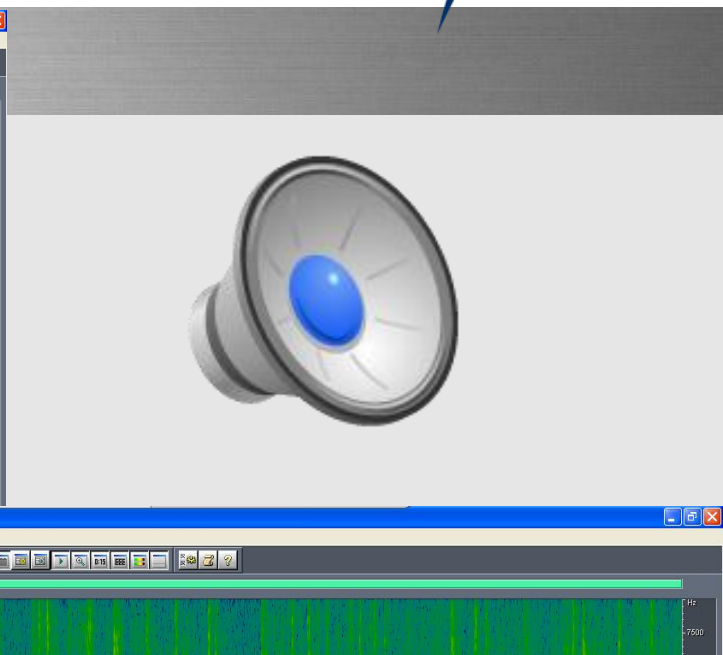
Versión sin testear audio

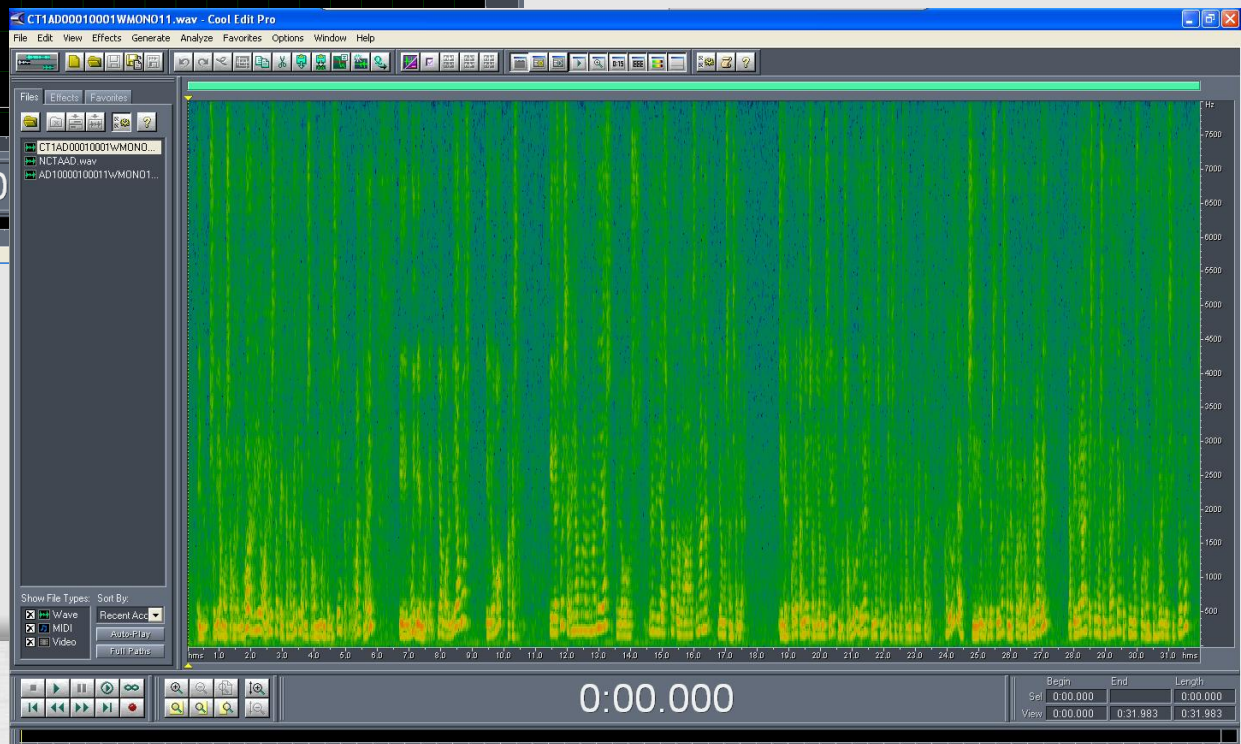
New approach, Emotion-Speech



New approach/ CONTROL

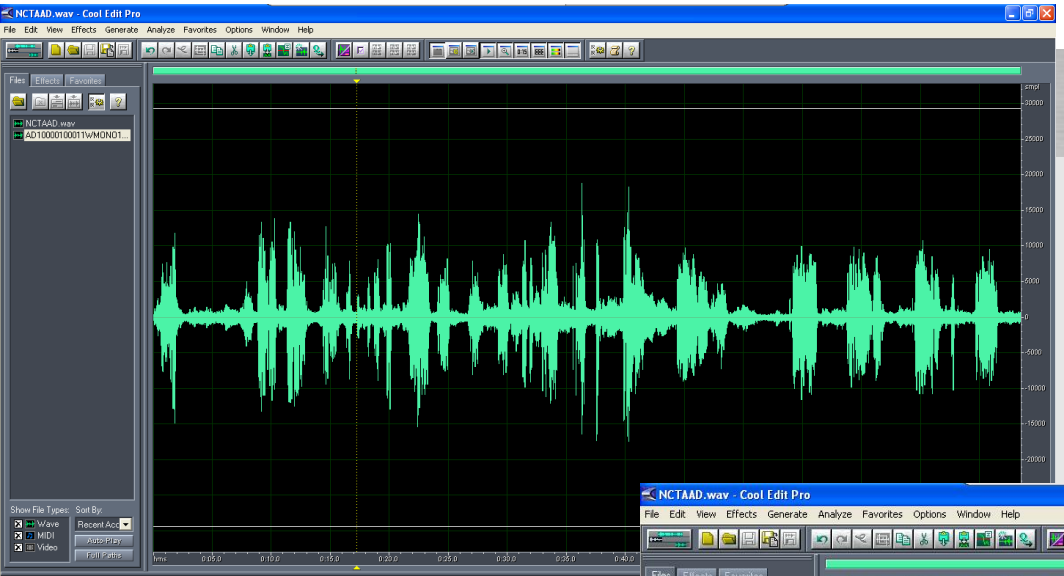


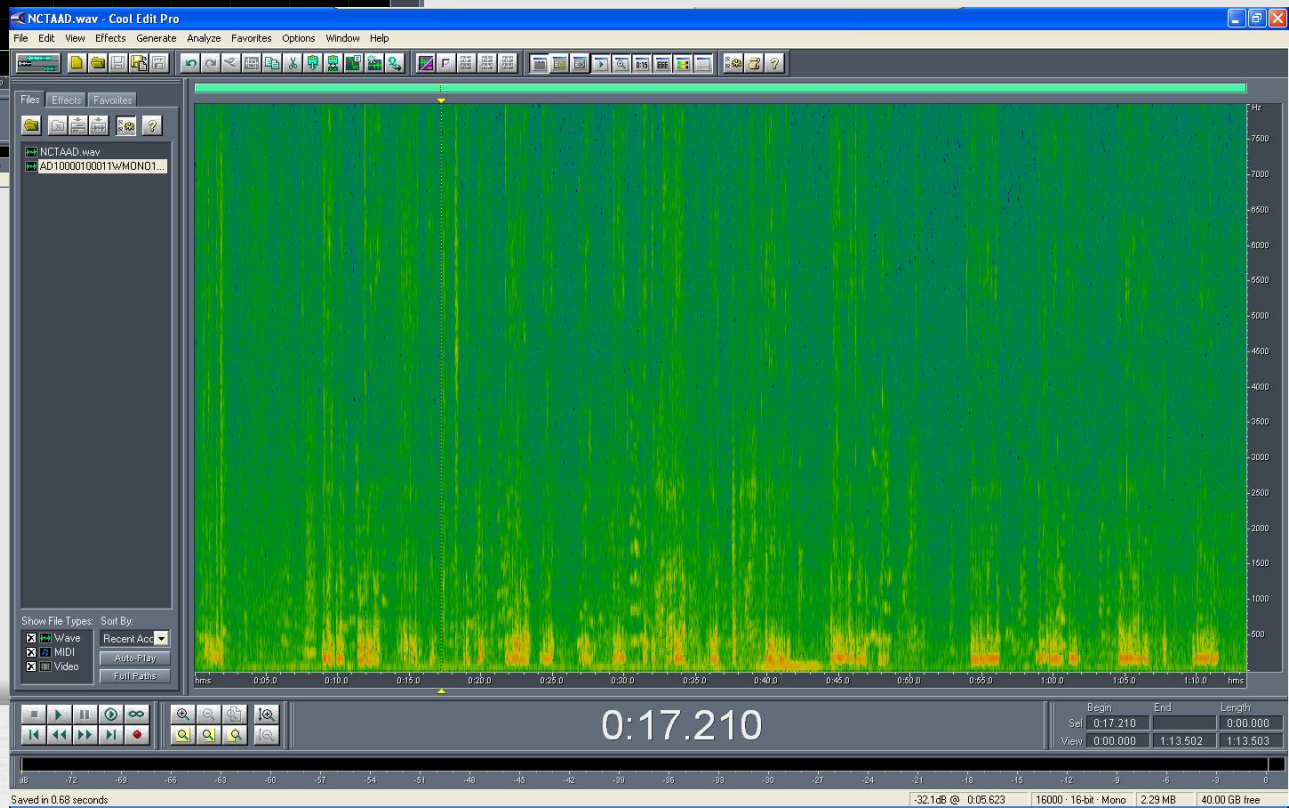




Brno 2012

New approach





New approach, Emotions

- Intelligent system (natural or artificial) need to face and survive a changing and partially unpredictable world
- Closely to learning and understanding process and are cognitive processes related to the architecture of the human mind
- Emotional information is transmitted through language. It essential in human communication/interaction with a high effect on intelligibility of speech.
- Use the same components subjective, cultural, physiological and behavioral that the individual's perception.
- Far from being an obstacle in understanding the universe, they describe it clearly. Emotional memory.

New approach/RekEmozio Database

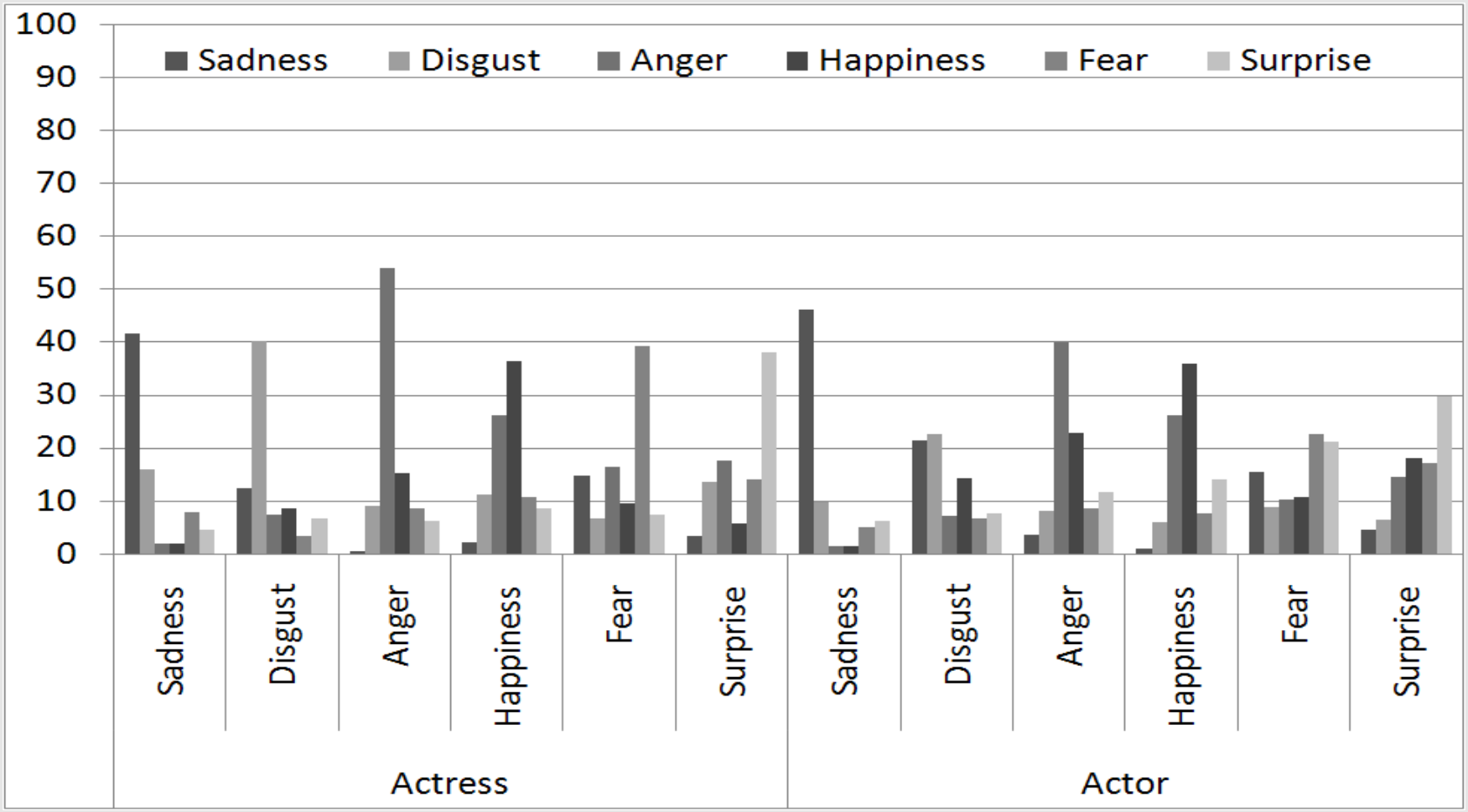
TABLE I
RekEmozio DATABASE

	Scope		Naturalness		Context
Language	**Description given of emotions**	**Number of actors/actresses-amateurs w/m**	**Emotion elicitation methods**	**Material**	**Mode**
Spanish Basque	sadness, fear, joy, anger, surprise, disgust; neutral	10 (5/5) 7 (4/3)-8(4/4)	Contextualized acting	2,618 audio stimuli/ 102 video stimuli	Audio-Visual

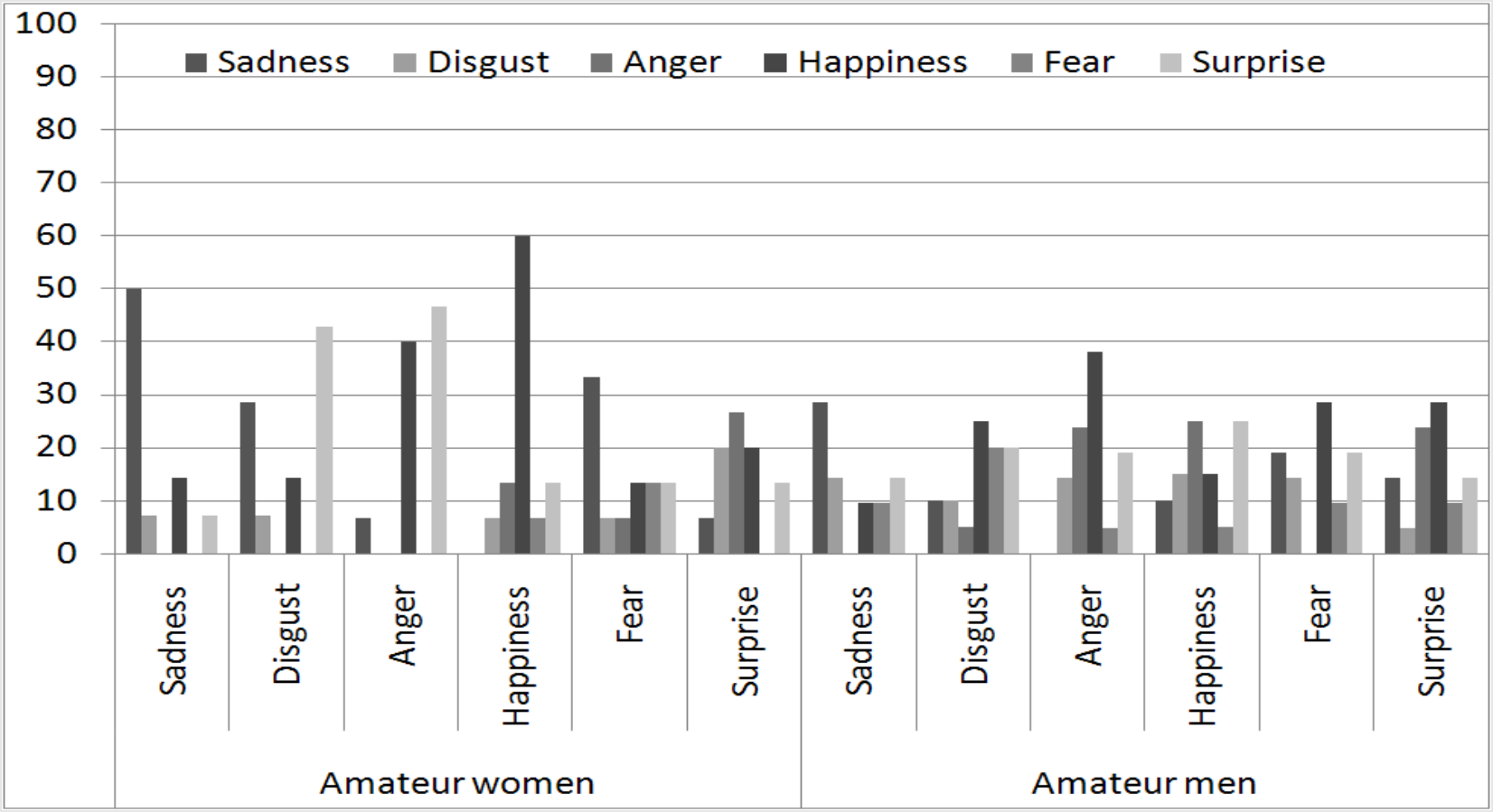
Actor-Basque

Amateur-Spanish

New approach/RekEmozio Database



New approach/RekEmozio Database



New approach

- Based on Automatic Speech Recognition and Emotion Analysis
  - Emotional Temperature (ET)

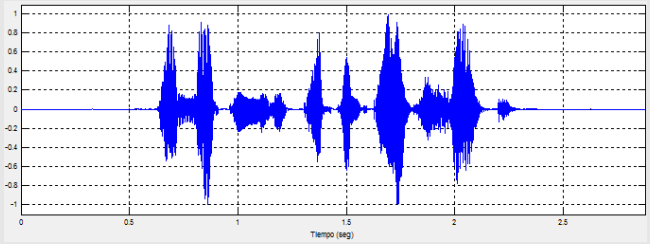
New approach

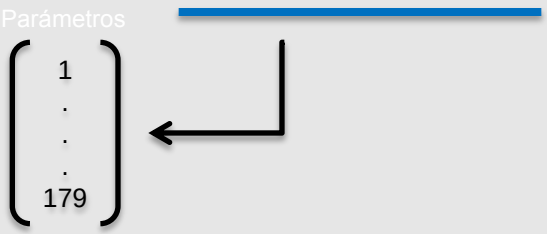
- Emotional Temperature (Alonso et.al, 2001)
- New strategy based on a few prosodic and paralinguistic features set obtained from a temporal segmentation of the speech signal.
- Parameter to define emotional level
- Independent with regard to cultural and environmental influence

New approach

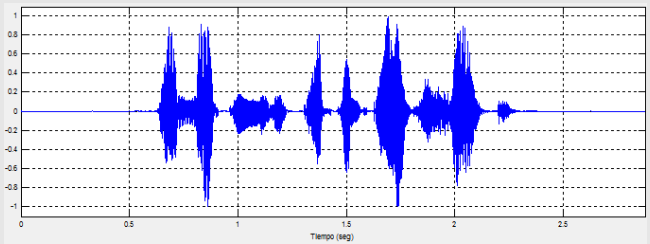
- Two prosodic features and four paralinguistic features related to the pitch and energy, respectively, are estimated from each frame.
- Robustness of these features in emotion recognition
- They are quickly and easily calculated
- They are independent of linguistic segmentation
- In real time applications in real environments can be avoided.

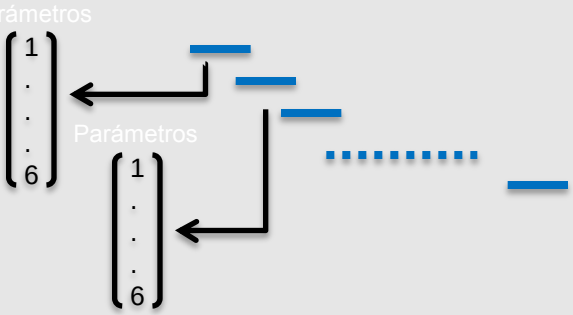
Classic Method

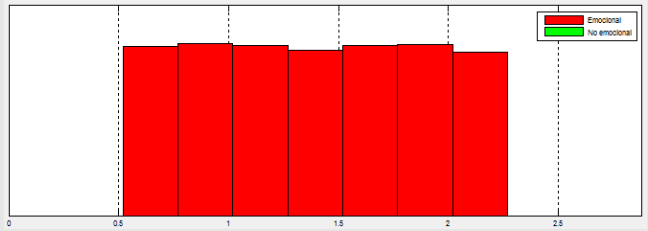




New proposal







Time Features

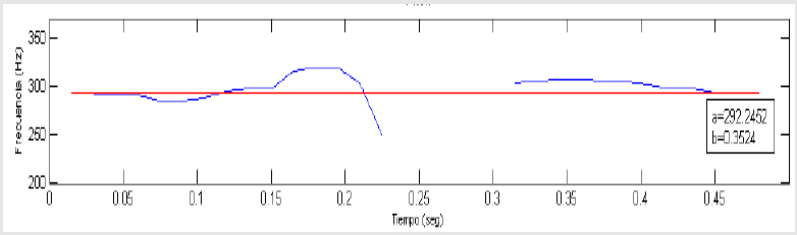
Features:

Time Segmentation (500ms window, 50%)

6 parameters (less computacional cost)

2 Two coefficientes from the first order polynomial approach of Pitch curve. Prosodic features

$$MIN(a,b) = \sum_{i=1}^{n} (p_i(n) - a - bx_i(n))^2$$



4 Energy percentage in frecuency bandsPorcentajes de Energía en bandas de frecuencia (Paralinguistic Features)

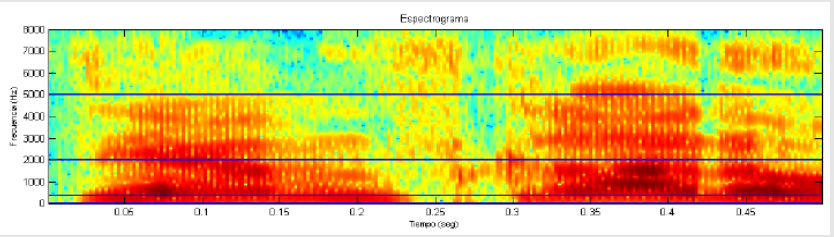
$$E_{B_i} = \frac{\sum_{f=B_i} |X(f)|^2}{\sum_{f=0}^{8KHz} |X(f)|^2} \quad 0 \le i \le 3$$

$B_0 = [0\,\text{Hz}, 400\,\text{Hz}]$

$B_1 = [400\,\text{Hz}, 2\,\text{kHz}]$

$B_2 = [2\,\text{kHz}, 5\,\text{kHz}]$

$B_3 = [5\,\text{kHz}, 8\,\text{kHz}]$



Classic Method, problems

The problem of linguistic segmentation in real environment:

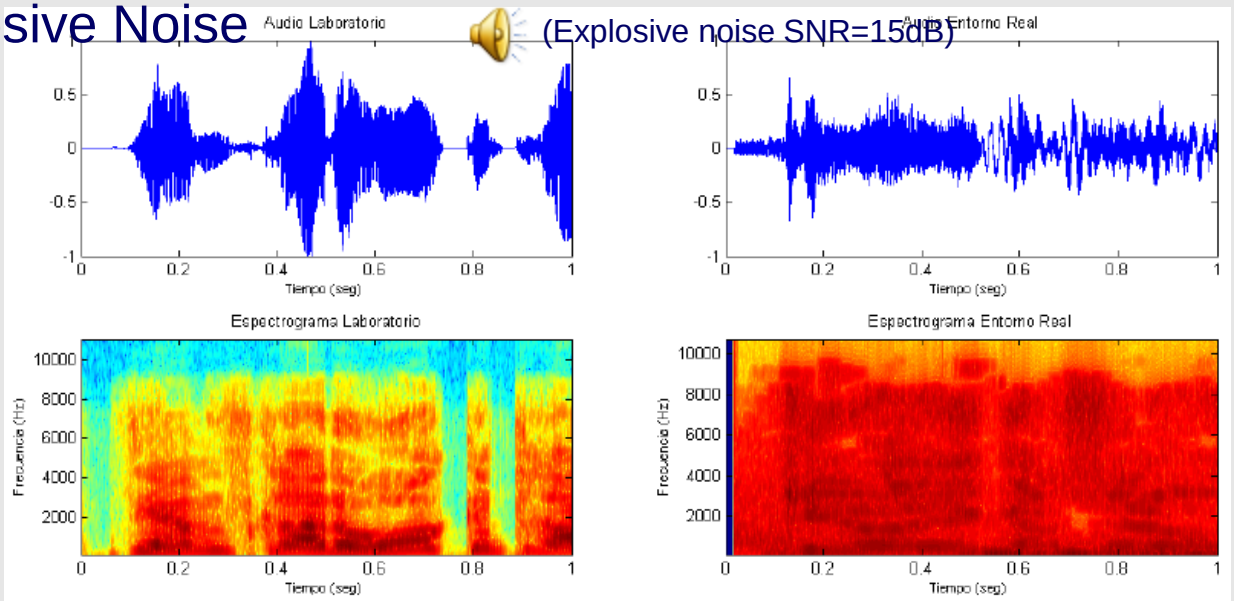
- Many speakers
- Non stationary noise
- Explosive Noise

(Original Audio)

(Many speakers SNR=-5dB)

(White Gaussian Noise SNR=-5dB)

(Explosive noise SNR=15dB)



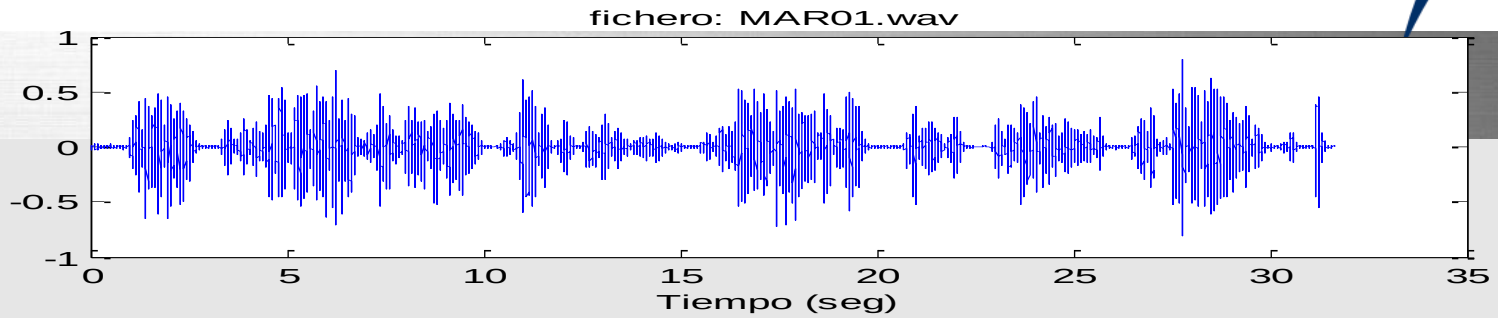
Outline

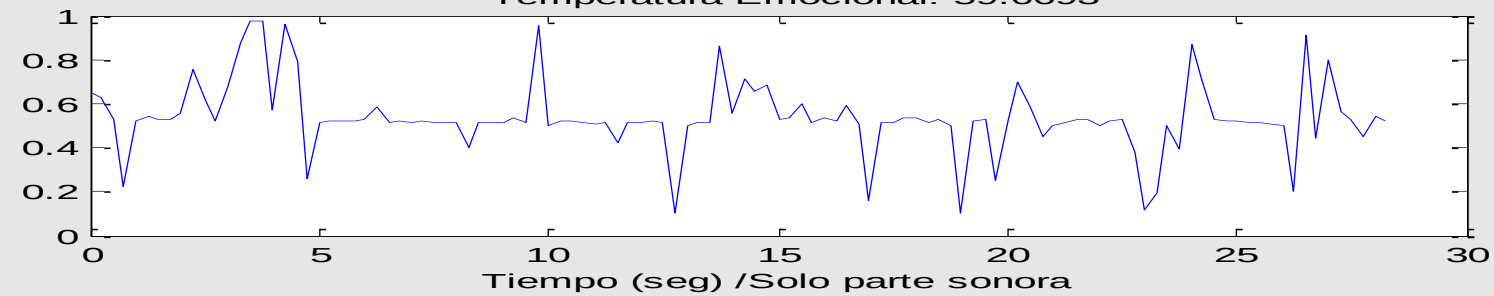
- Alzheimer Disease (AD)
- Diagnosis of AD
- New approach
- Methods
- Experimentation
- Concluding Remarks

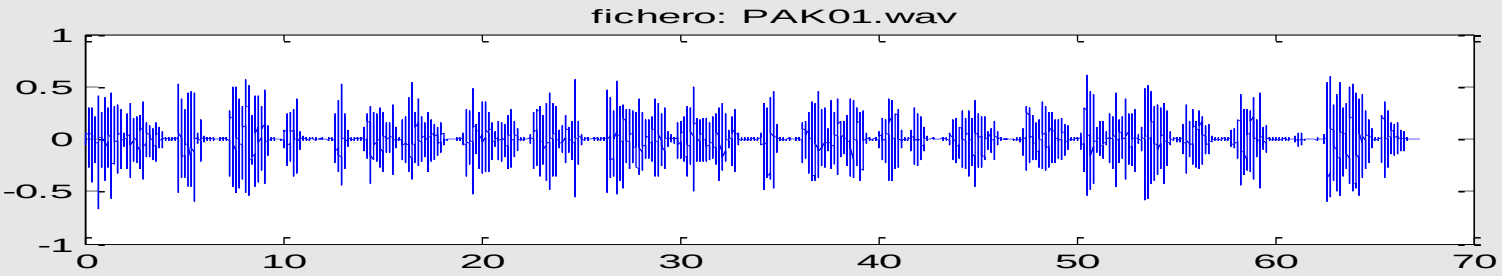
Experimentation

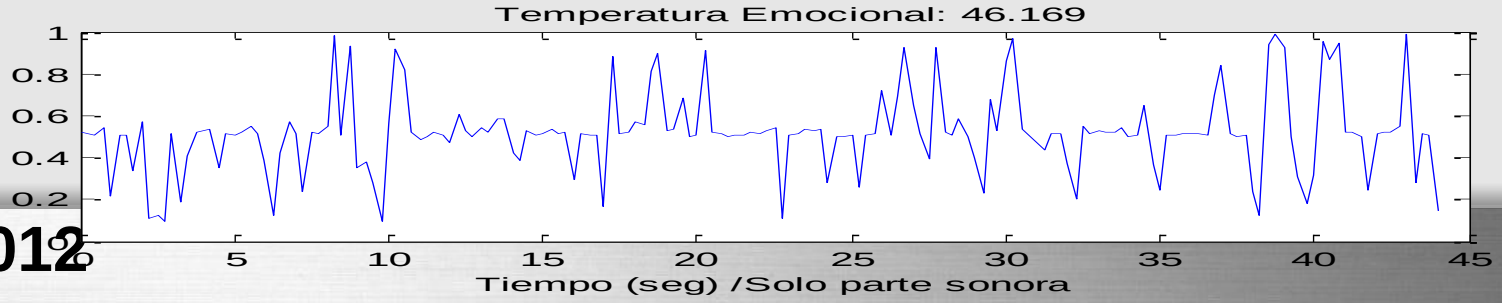
- Features of the Database (multicultural and multilingual):
  - 10 hours of Spontaneous Speech from enjoyable personal stories
  - 1 hour of people with AD
  - 9 hours of control people
  - Recording atmosphere is relaxed and non-invasive.
  - Speech Segment of 60 seconds
  - 600 segments of Spontaneous Speech.

Experimentation

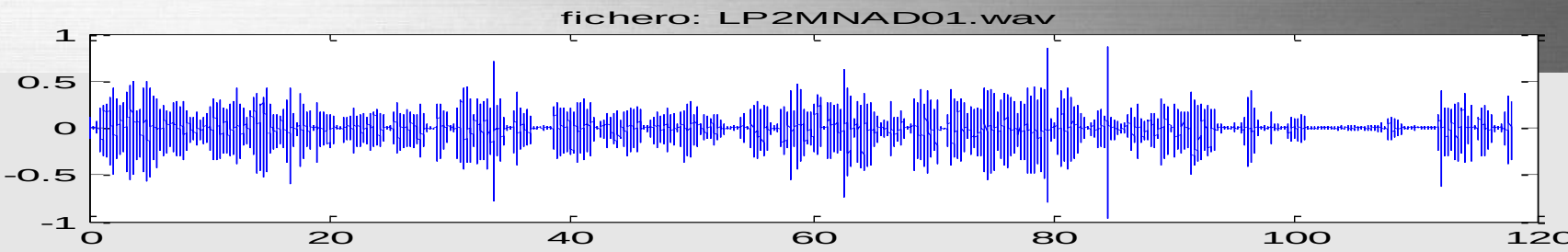


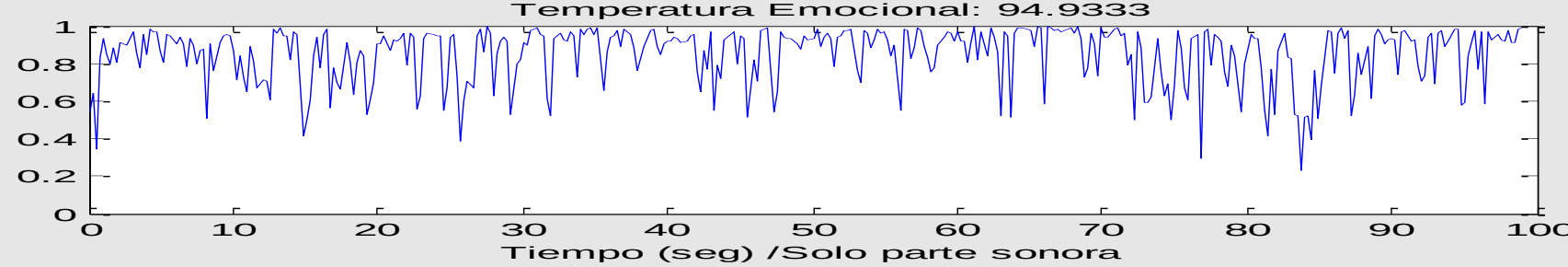


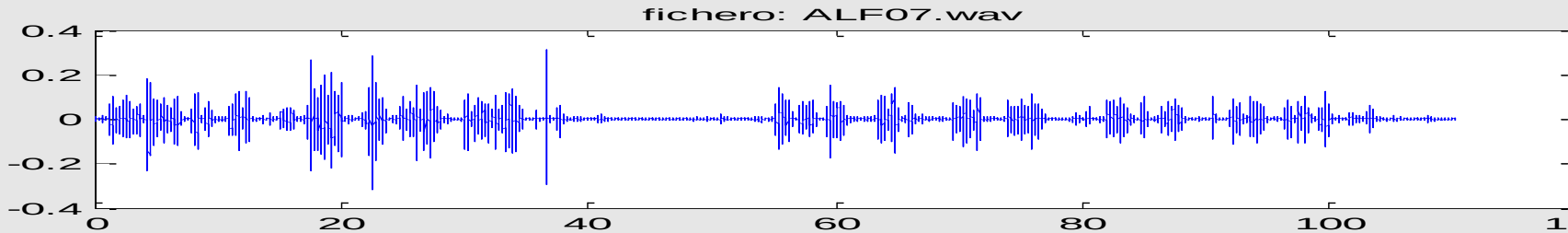


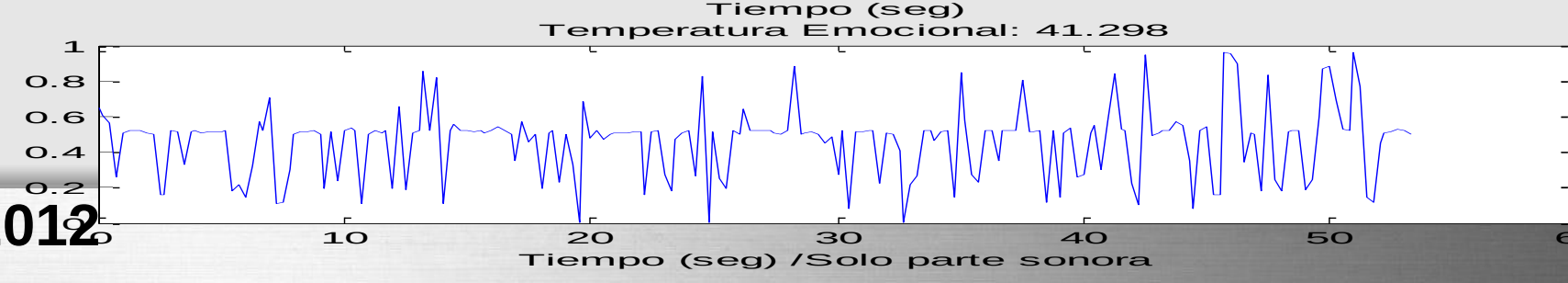


Experimentation

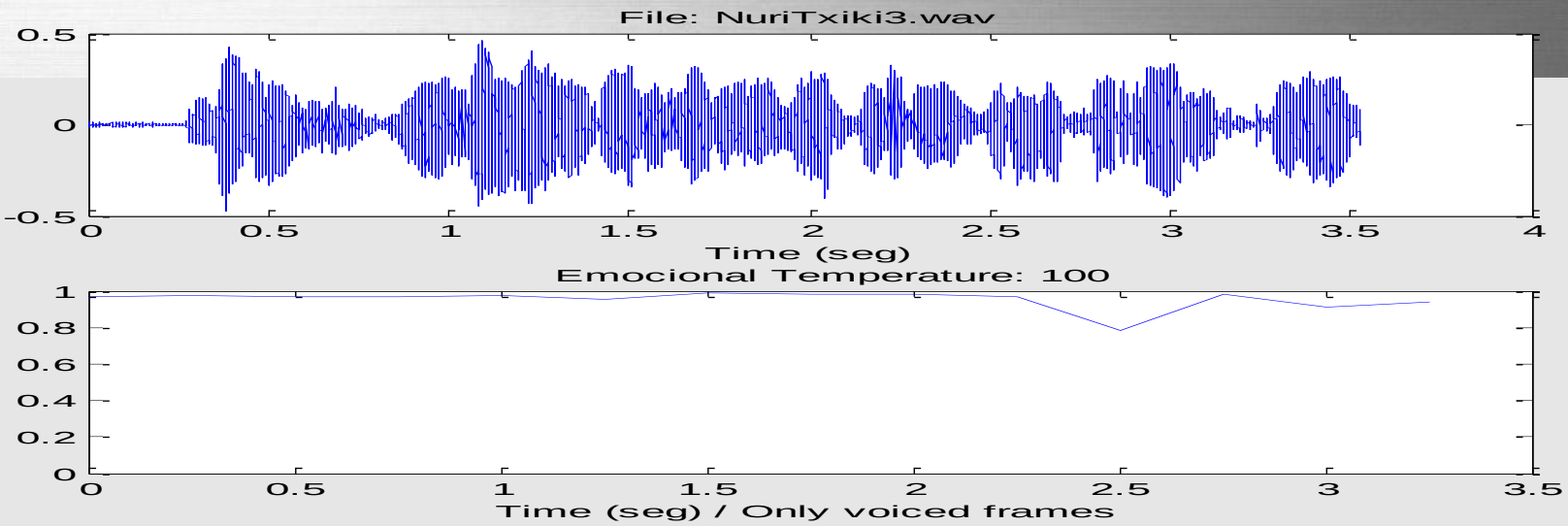


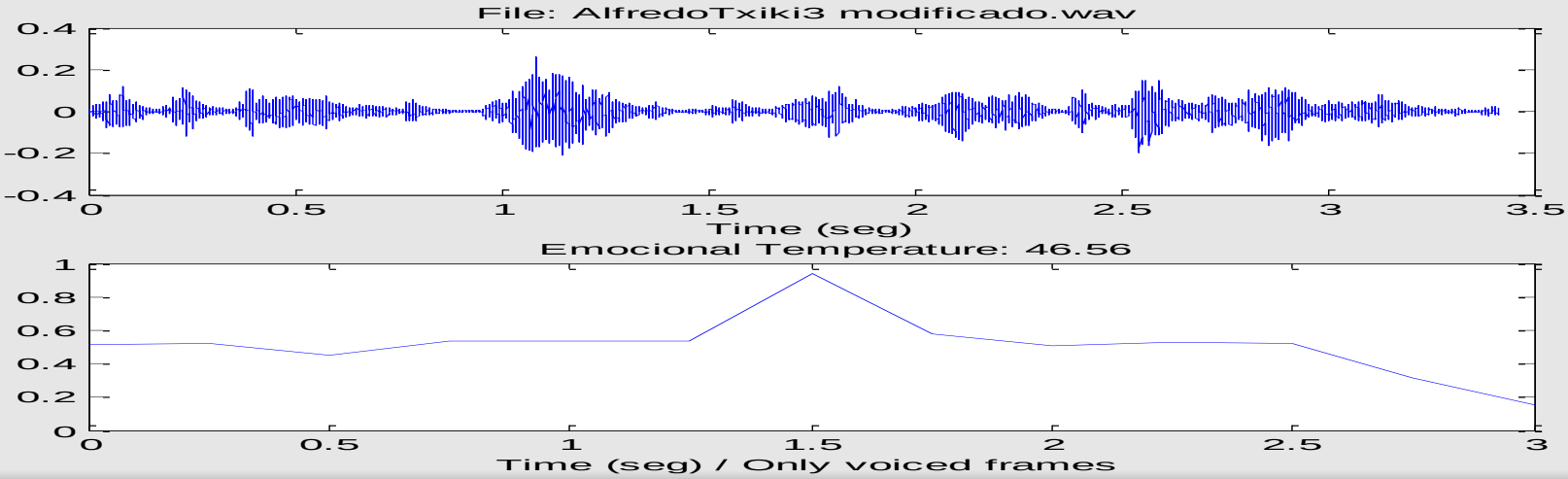






Experimentation





Outline

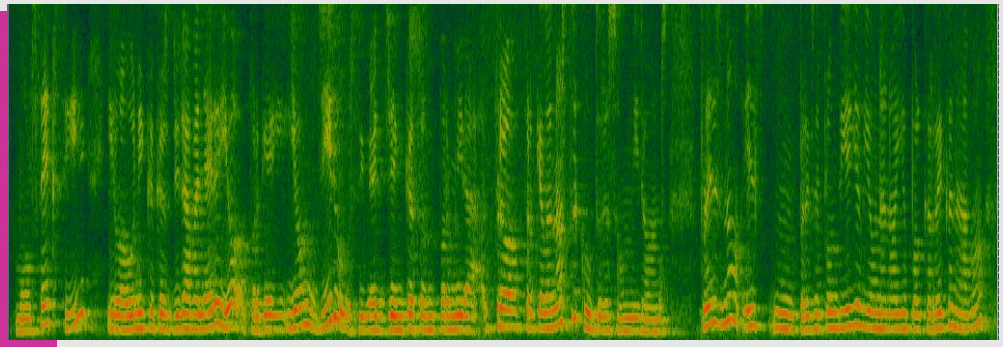
- Alzheimer Disease (AD)
- Diagnosis of AD
- New approach
- Methods
- Experimentation
- Concluding Remarks

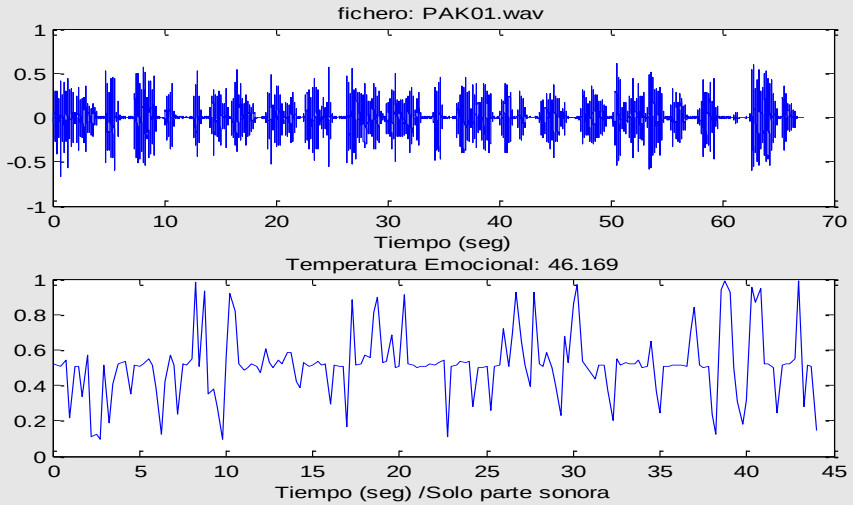
Concluding Remarks

- New approaches for AD early diagnosis
- Diagnosis by non-invasive automated intelligent methods, low cost methodologies and have no side effects.
- New method based on Emotional Temperature (ET).
- Database multicultural and multilingual
- Encouraging results showing tendencies to explore with a broader population.

Ongoing Works

- To integrate the described methodologies with automatic analysis methods of drawing and handwriting as well as with automatic analysis of facial features, Spontaneous Speech Analysis.
- To extend the analysis population
- To extend the type of pathology (Parkinson Disease and depression).
- To integrate in standard test such as semantic tests (animals)
- New experimentation with PGA study in CITA-Alzheimer
- Pattern Recognition Models
- Fusion with other Biomarkers
- One Class Classifier
- AZTI-BiziUP system development, GNU





K. López de Ipiña,

Systems Engineering and Automation dept.

Univ. Basque Country

karmele.ipina@ehu.es

J. B. Alonso Hernandez

jalonso@dsc.ulpgc.es

University of Las Palmas de Gran Canaria

IdeTIC