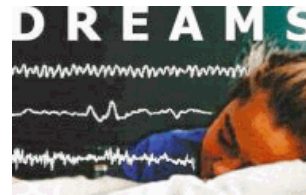
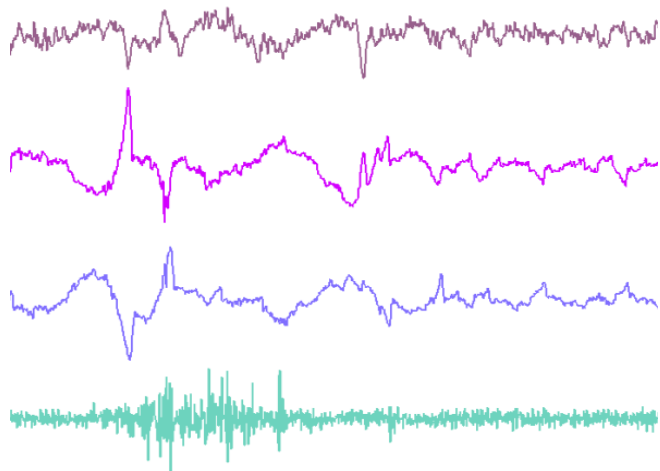




POLYTECH.MONS

PAI DYSCO Meeting

Ongoing research on biomedical signals at FPMs/TCTS Lab



BIOFACT

Prof. Thierry Dutoit

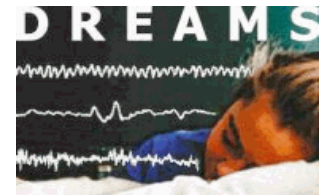
Dr. T. Castermans, S. Devuyst, T. Ravet, J. Tilmanne, T. Dubuisson



Research axes

1) Sleep/sedation/anesthesiology analysis

- Automated analysis of polysomnographic signals
- Computer-based assistance for anesthesiologists



2) Voice pathology detection

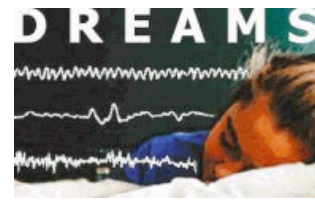


3) Walking rehabilitation

- An intelligent lower limb prosthesis
- Gait simulation

BIOFACT

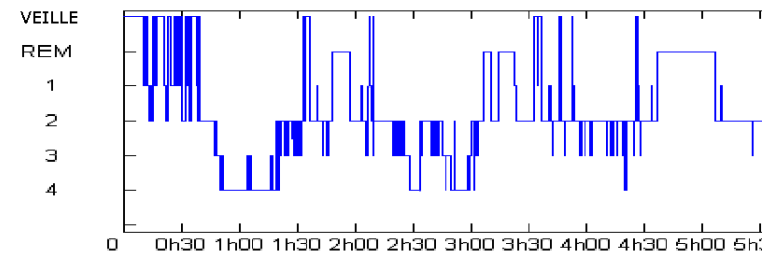
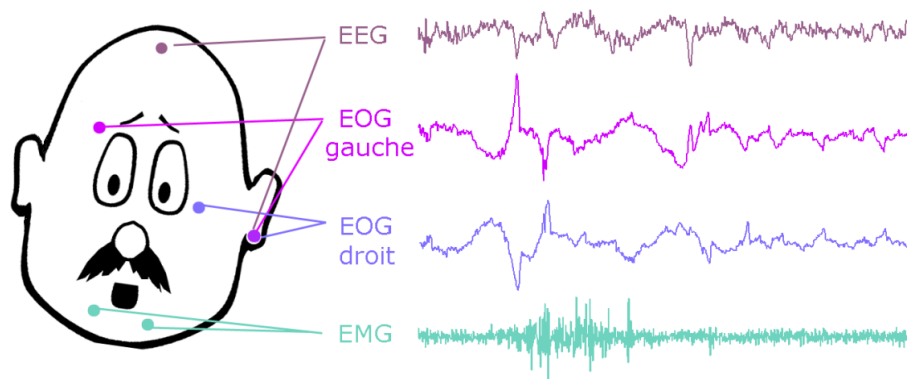
Polysomnographic signals



Polysomnographic
signals



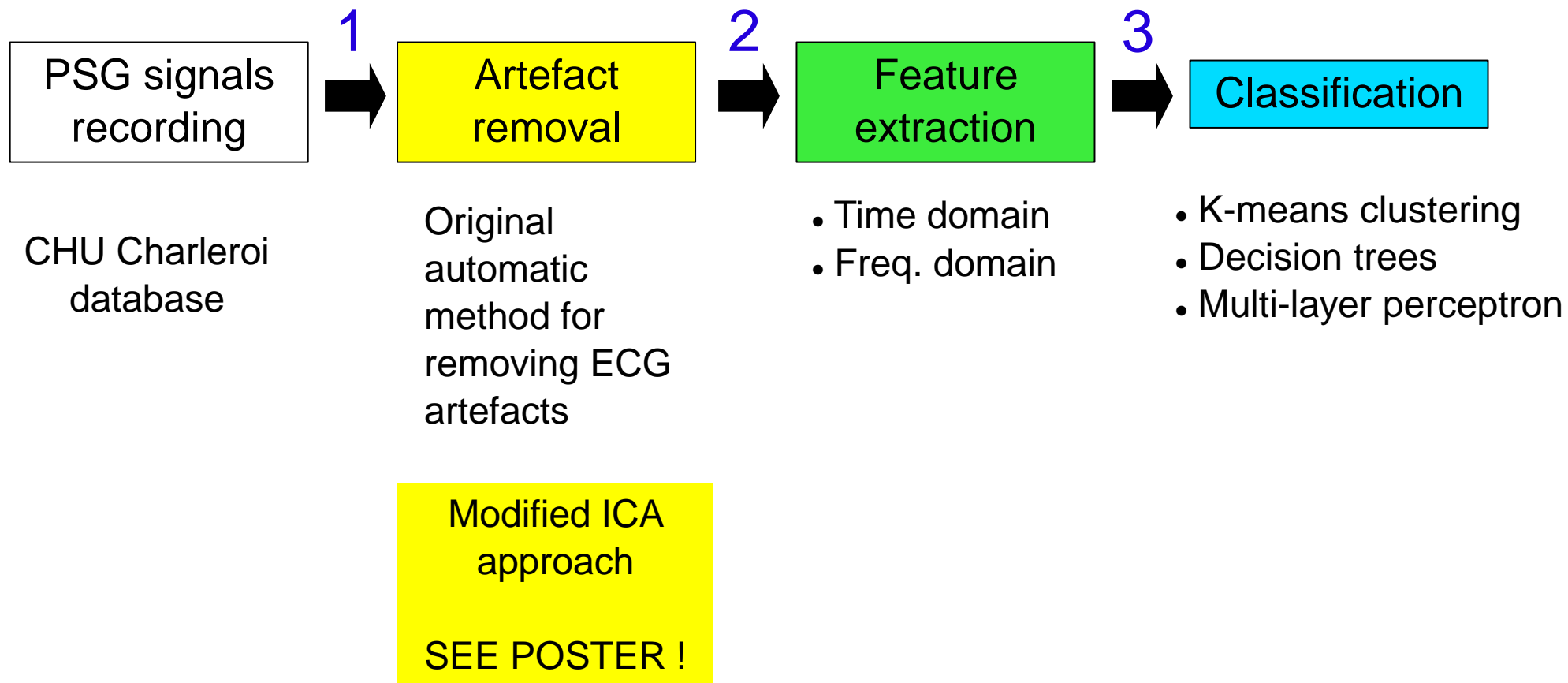
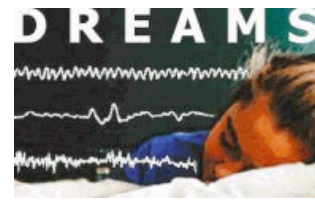
Hypnogram
(sleep stage vs time)



Goals:

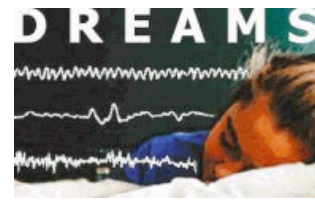
- ❑ Speed-up the classification
- ❑ Provide objective classification criteria

Polysomnographic signals



S. Devuyst, T. Dutoit; P. Stenuit, M. Kerkeghofs, E. Stanus, 2008, *Cancelling ECG Artifacts in EEG Using a Modified Independent Component Analysis Approach*, EURASIP Journal on Advances in Signal Processing

Polysomnographic signals



Results

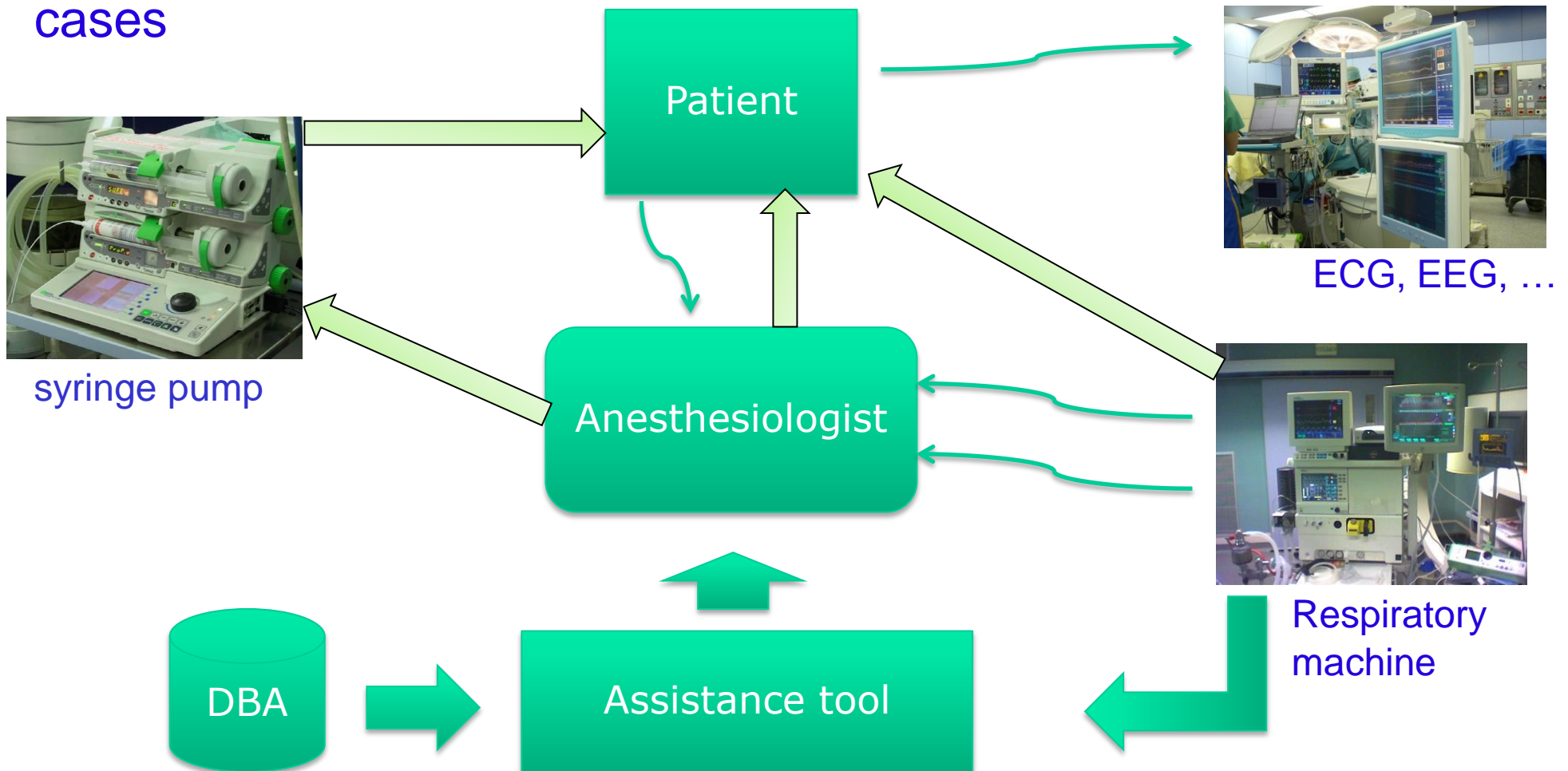
Recognition rate	NN alone	NN with REM	NN with REM23	For est	Forests REM	Forests REM23
Patients	69,47	70,21	71,83	71,00	73,21	75,07
Subjects	79,79	81,14	81,62	81,28	82,70	82,93

NB: commercial software on the same database : 50/57 %

Anesthesiology



Design of a computer-based assistance tool for anesthesiologists, using a database of previous anesthesiology cases



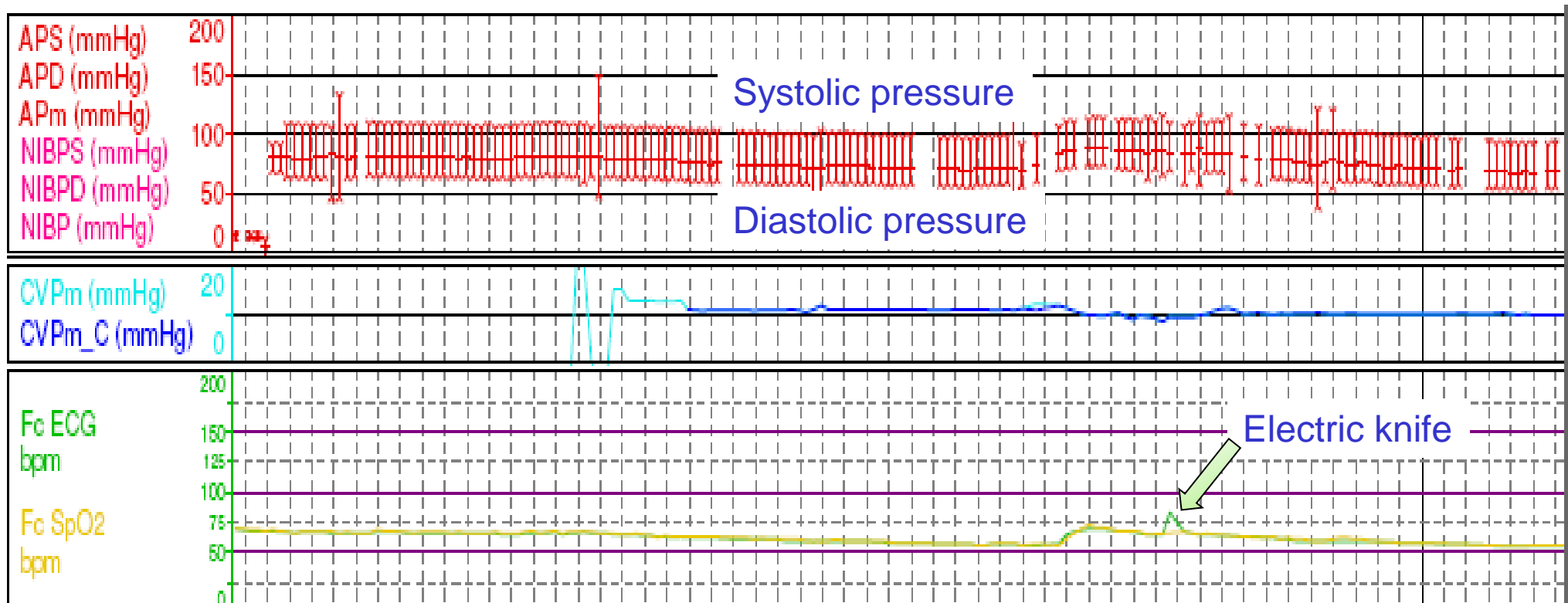
Challenge:

Predict physiological parameters as a function of administered analgesics and hypnotics

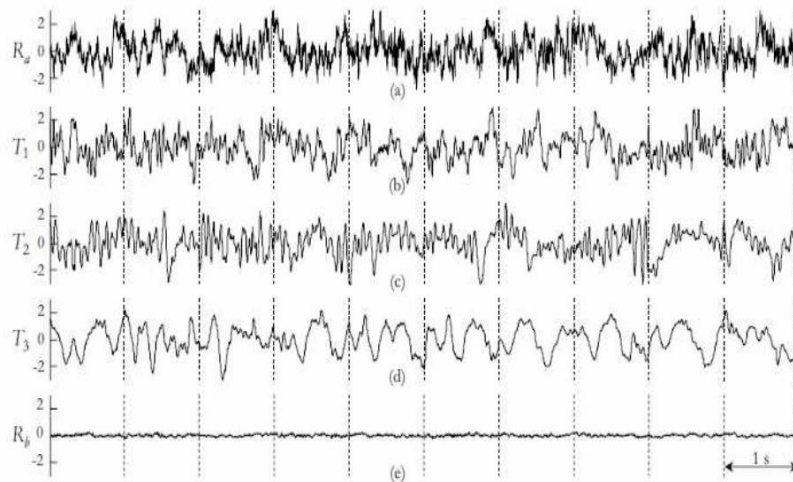
Tasks:

- *Artefact detection/correction, fusion of parameters (TCTS Lab)*
- *Automatic detection of key phases in the surgery (TCTS Lab)*
- *Study of depth of anesthesia (follow up of S. Bibian's PhD, U. Vancouver) (TCTS Lab)*
- Data mining (Machine Learning Group, ULB)
- Software and hardware wrap-up (MLG, ULB)

Artefact detection/correction and parameter fusion : an example



NeuroSense's wavelet based Depth of Anesthesia monitor



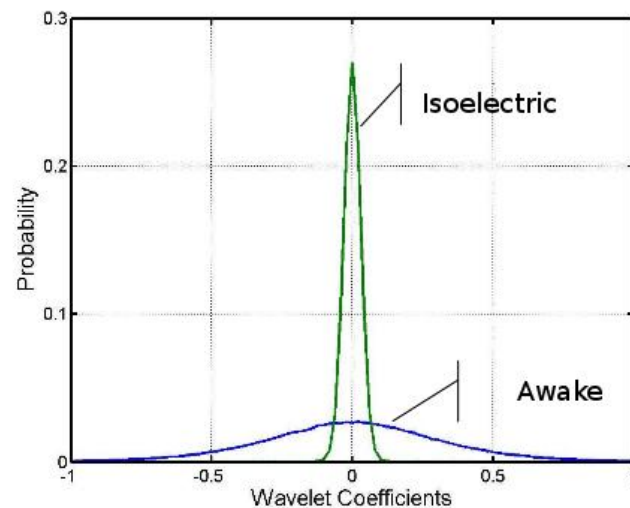
EEG of a patient awake

Rapid Eye Movement (REM)

Anesthesia

Deep anesthesia

Isoelectric state



Statistical distribution of the wavelet coefficients (32-64 Hz) for the isoelectric and 'awake' states.

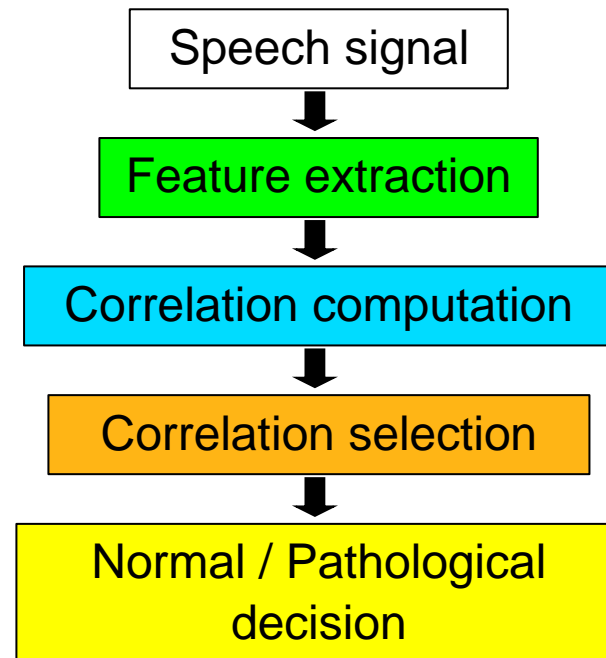
The DOA index is computed from the distances between the current EEG epoch and those 2 extreme cases.

(Follow-up of S. Bibian's PhD, U. Vancouver)

Voice pathology detection



Goal : design acoustic descriptors in order to discriminate between normal and pathological speech samples

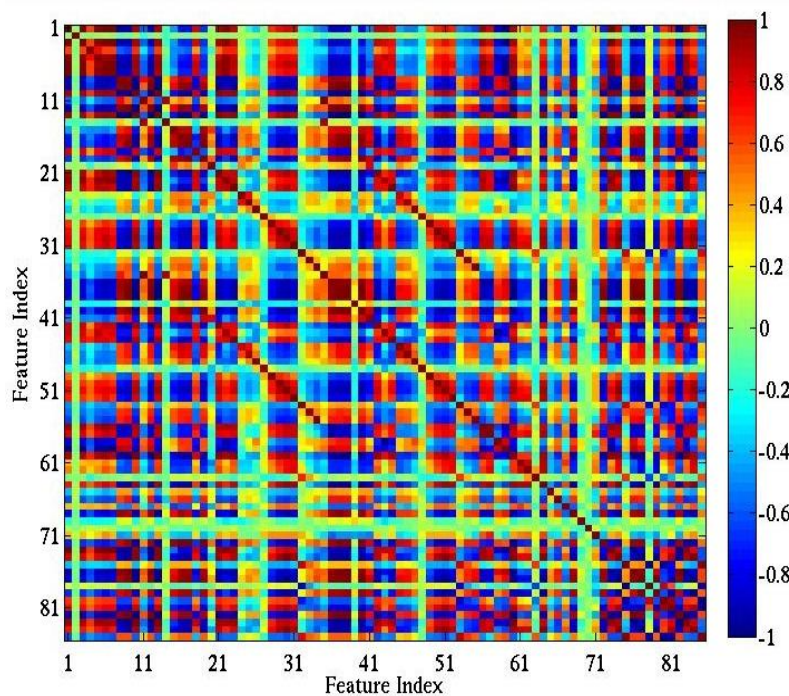


SEE POSTER !

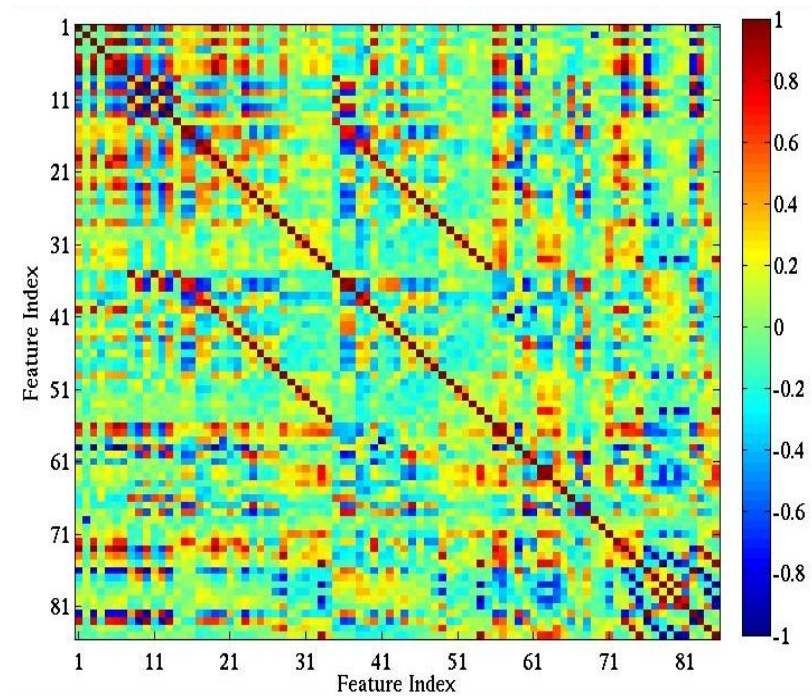
Voice pathology detection



85 acoustic descriptors (time and freq. domain, source and filter) are measured and their correlations are computed over a sustained vowel



Normal subject

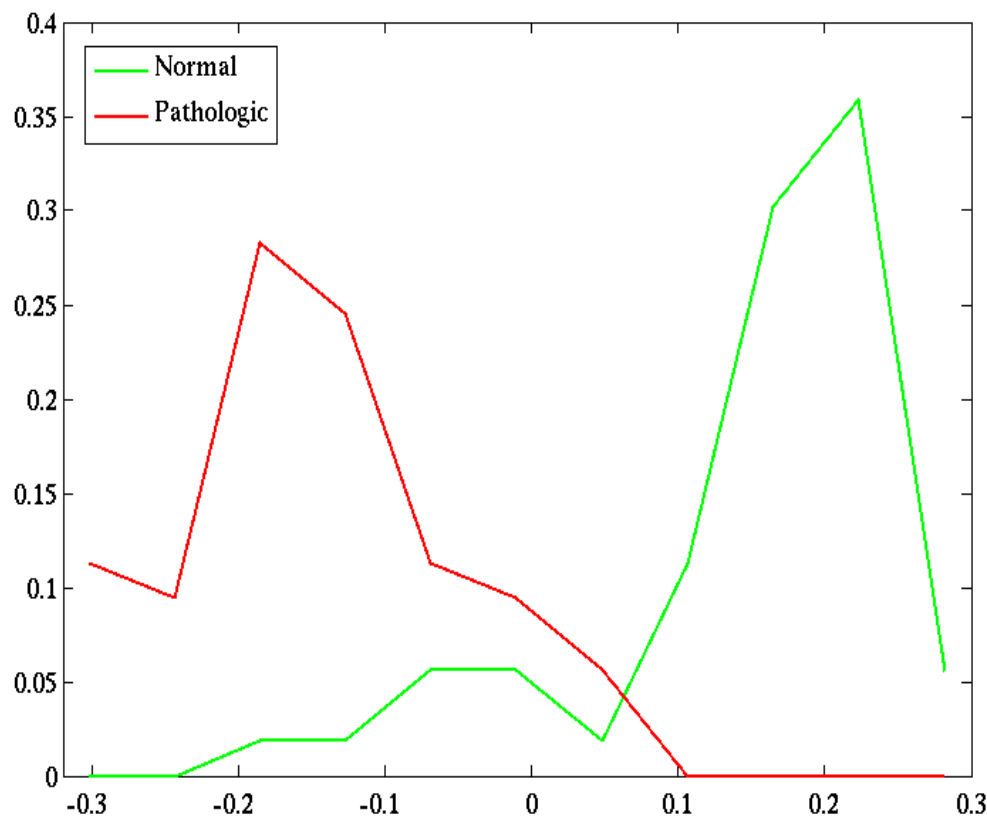


Pathological subject

Voice pathology detection



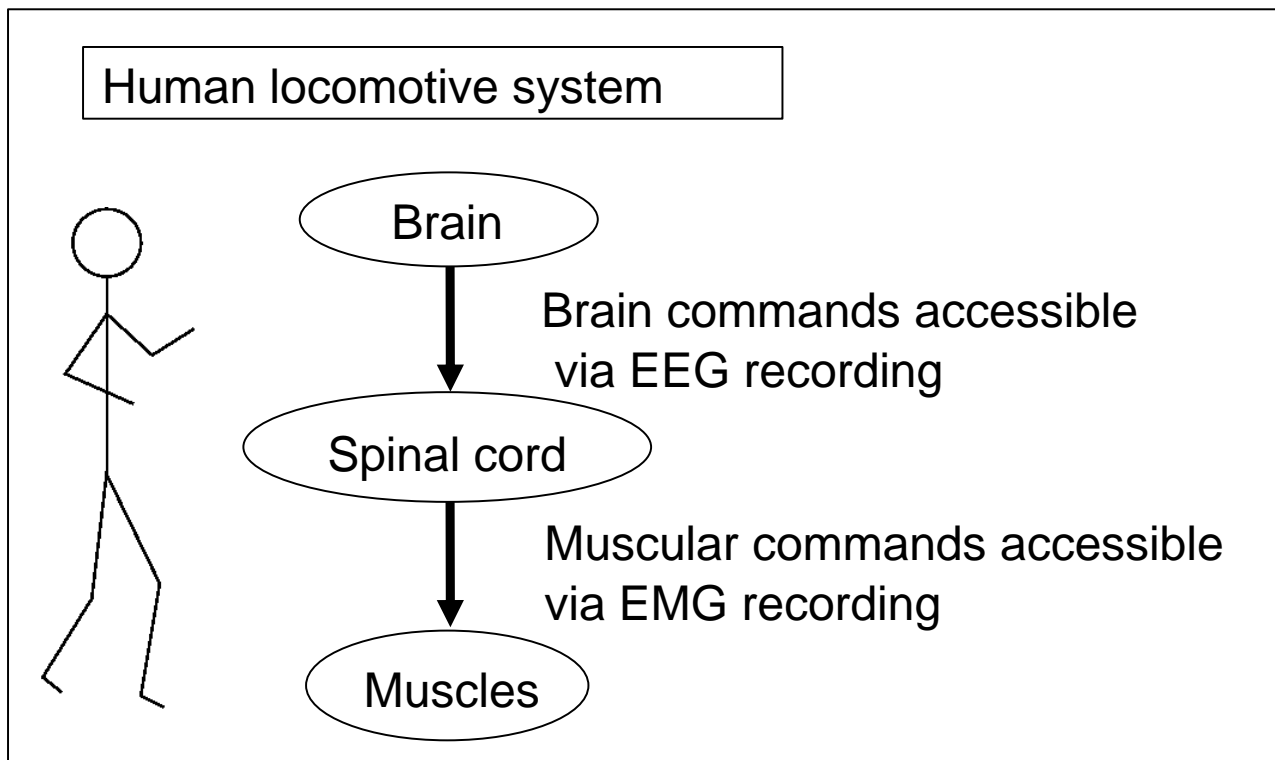
The two most discriminant correlations are selected and used for the normal/pathological discrimination



	Manual Patho	Manual Normo
Auto Patho	0.963	0.169
Auto Normo	0.037	0.831

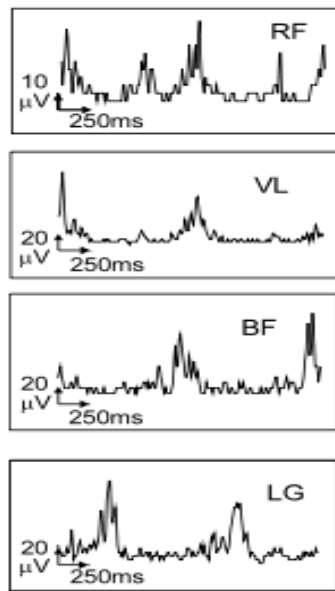
T. DUBUISSON, T. DUTOIT, B. GOSSELIN, M. REMACLE, 2009, "On the Use of the Correlation between Acoustic Descriptors for the Normal/Pathological Voices Discrimination", *EURASIP Journal on Advances in Signal Processing*, Analysis and Signal Processing of Oesophageal and Pathological Voices, 2009.

An intelligent lower limb prosthesis, driven by an original brain-computer interface (BCI)

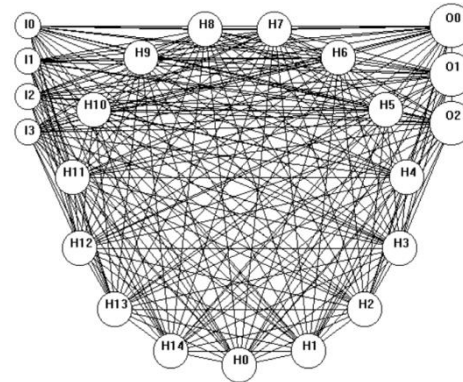


A dynamic recurrent neural network (DRNN)

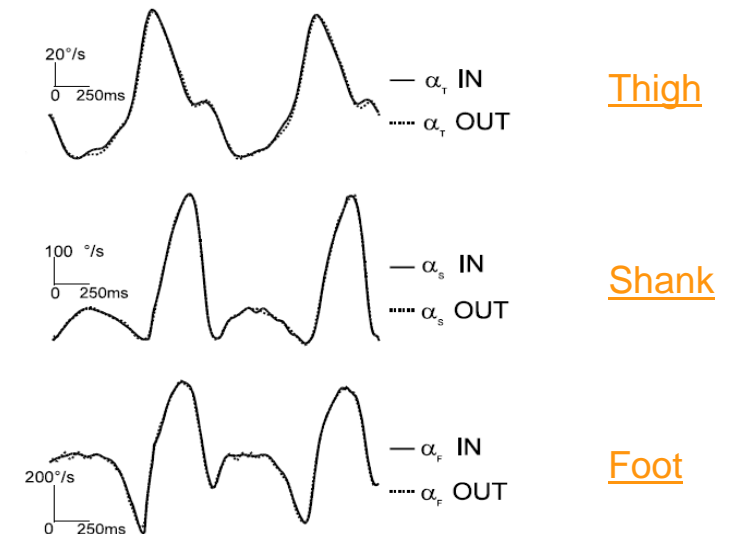
INPUT = EMG signals



DRNN



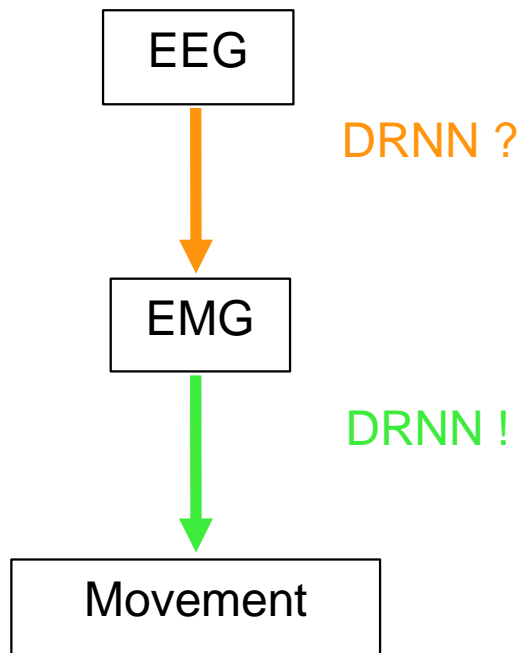
OUTPUT = 3 angles of elevation (thigh, knee, foot) with respect to the vertical axis



The DRNN is able to reproduce complex human movements from realistic EMG signals (FPMs, 1990's).

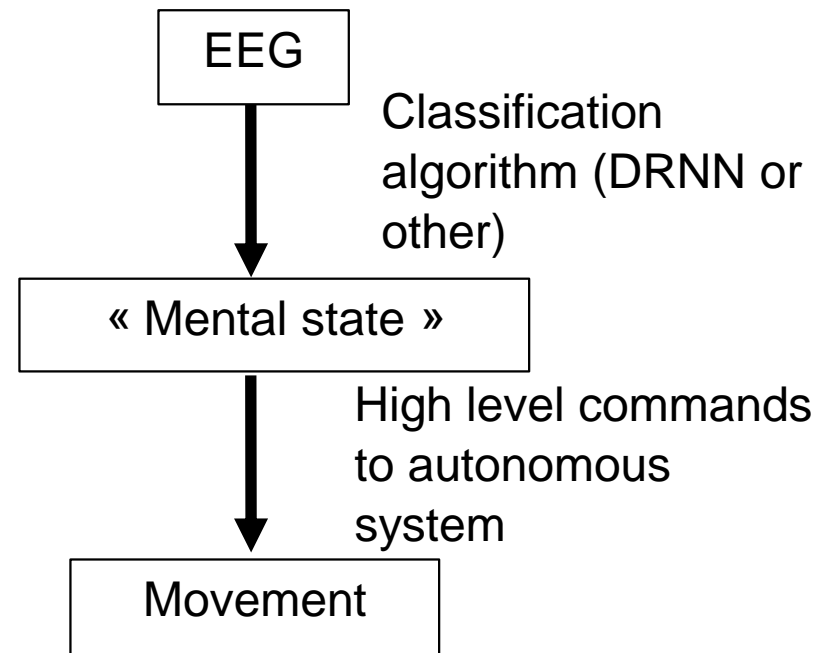
SEE POSTER !

Interface A



Interface A is also suitable for the functional electrical stimulation (FES) of paralysed limbs.

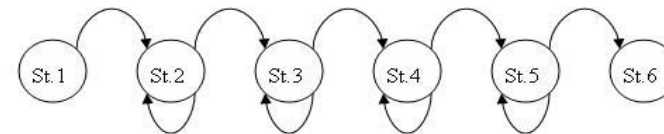
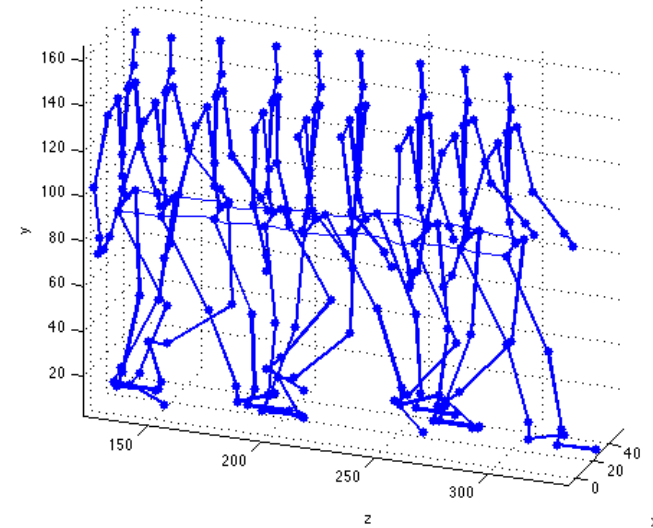
Interface B (more traditional BCI-like)



Interface B is easier to set up but requires an adequate gait simulation. This study is also ongoing in our lab.

- **Aim:** modeling the human gait from measurements on a motion capture suite (IGS-190, Animazoo)

IGS-190



Hidden Markov Model-based analysis-synthesis (links to statistical parametric synthesis of speech)

Study of walking/dancing styles

TCTS lab biomed collaborators

DREAMS



UCL-TELE



CHU Charleroi

TANIA



ECLIPSE



ULB-LIST



BIOFACT



Le Fonds Européen de Développement Régional
et la Région Wallonne investissent dans votre avenir.

