Cours de traitement des signaux biomédicaux
5th Matlab session

Useful commands
ARyule AR model estimation, autocorrelation method, uses Levinson-Durbin.
ARcov AR model estimation, covariance method.

Remarks
With the command :
>> [a,e] = ARyule(x,p) ;
You get the vector a of model (predictor) coefficients and the variance e of the excitation (prediction error).

Additional commands
AR_order estimation of optimum order using MDL criterion.
AR_psd power spectral density parametric estimation
pisarenko sinusoidal component estimation using Pisarenko

Experiment 1 : Detection of vasovagal syncope
We are going to use AR modeling to highlight the differences between regions of the non-stationary signal in **heart_5.dat**. this file is a record of a vasovagal syncope, (some explanations in **readme_heart.txt**). Use the first column, i.e. the RR intervals regularly resampled at 4 Hz.

1. Divide this signal into 5 intervals of length 500 and estimate a 5-order AR model on each interval (you can check this is an appropriate order value). *Do not forget to remove the mean value on each interval.* Check that the model coefficients are similar before the ″aborted″ syncope that takes place between the 500th and 1000 th samples and the ″true″ one at the end of the recording, and also similar during these two events.

Experiment 2 : signal organization
Load the signal in file **AF_sync.dat**. Plot the parametric estimate of the power spectral density of this signal in three 500-sample windows corresponding to the three regimes (cf. lab of last week, episode of organization between 2000 and 3000) using AR_psd with an order of 20. Is the organization/disorganization pattern confirmed?

Experiment 3 : parametric spectral estimation of cardiovascular signals
2.1 Extract again the RR-interval, arterial pressure and respiration signals from files **heart_1.dat** and **heart_2.dat**. remove the mean values, and subsample the signals by a factor of 4 (the sampling frequency becomes 1Hz). Perform a parametric spectral estimation of all signals (use an order 15). Compare the results with those obtained using non-parametric spectral estimation.
2.2 Same procedure for the signals in **heart_4.dat**, but add a detrending with envelopes (window length 31) after resampling and remove the mean of the detrended signals. Use an order 25 for parametric spectal estimation. What is the main feature, due to the Cheyne-Stokes respiration pattern induced by altitude (4000 m)?

Experiment 4 : deep brain electrical stimulation, EEG, and Pisarenko – what a show !

File **EEG_stim.dat** contains three columns corresponding to three recordings (sampling frequency 512 Hz) of EEG activity (left frontal electrode) from a Parkinsonian patient implanted with a deep brain stimulation electrode

The1st column corresponds to rest state, the 2nd to a 1 Hz stimulation, the 3rd to a 100 Hz stimulation. Apply pisarenko, 5 sinusoids, to the three recordings to get their harmonic content.

1. which stimulation seems to effectively influence cerebral activity ?
2. Is this influence linear ?