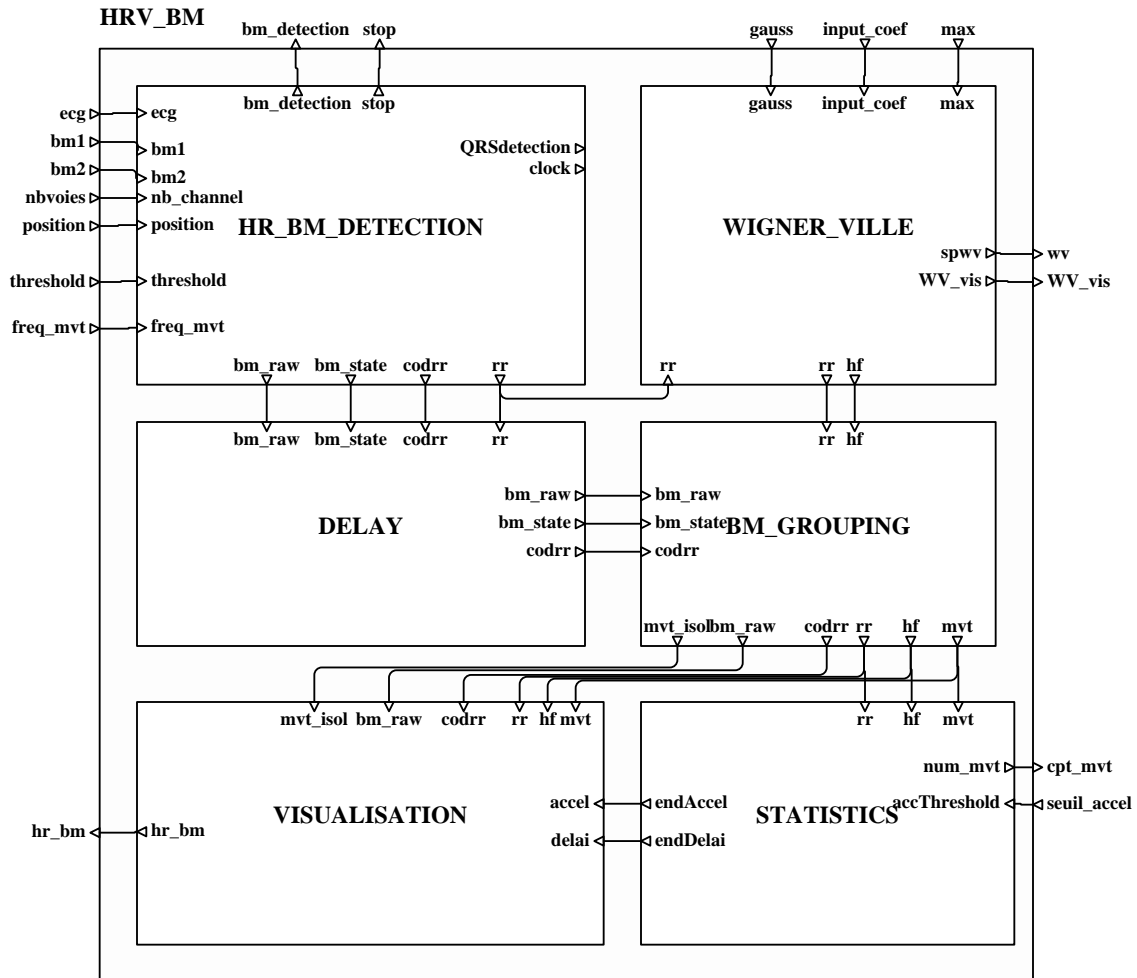


Process : Lary_c/HRV_BM

Comment

Computation of Heart Rate variables, according to the Body Movements occurrences

Diagram



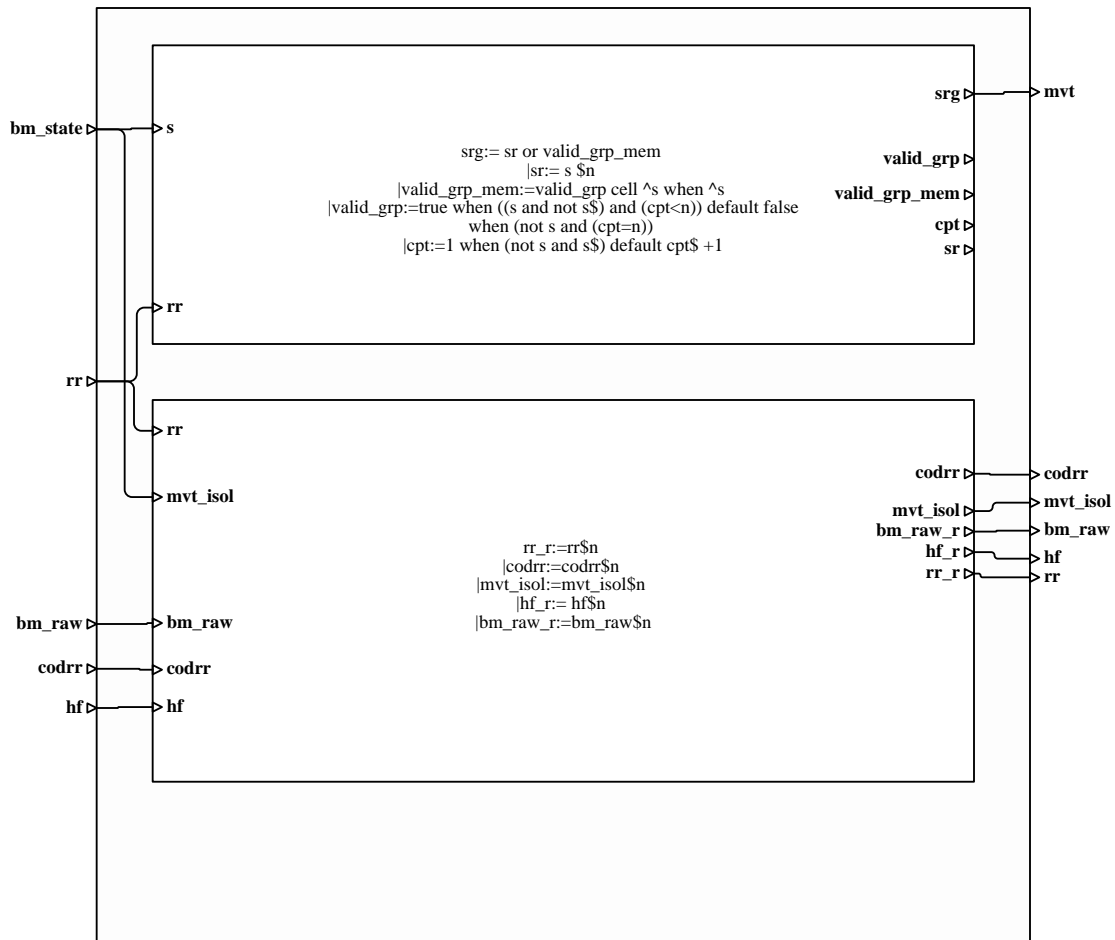
Process : BM_GROUPING

Comment

Body Movements are grouped when they are separated from less than n RR; as the output boolean signal 'mvt' is computed with a delay of n RR, the others signals are also delayed by n RR.

Diagram

BM_GROUPING



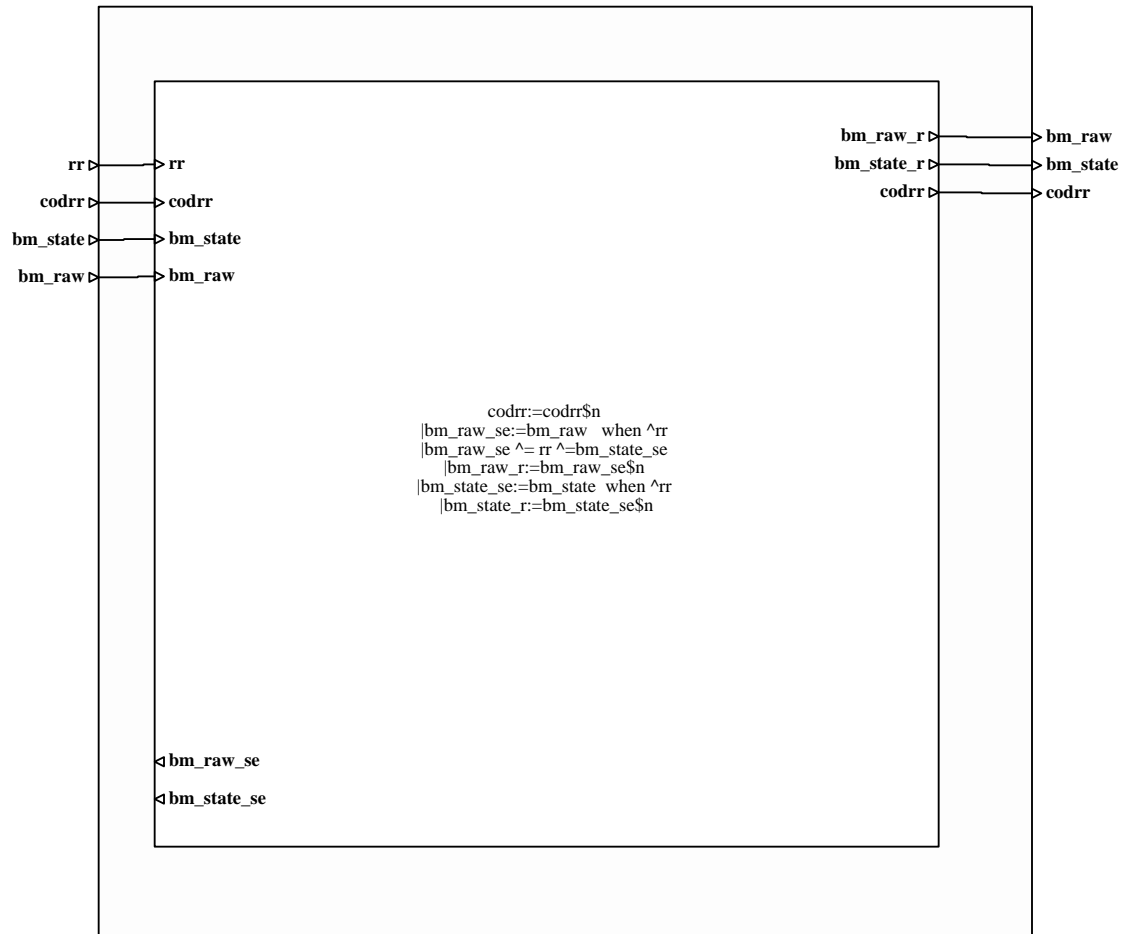
Process : DELAY

Comment

This process corrects the delay between the input signals and the output signals of the Wigner Ville; it also synchronise the rhythms of Body Movements (bm) with the Heart Rate (rr) rhythm.

Diagram

DELAY

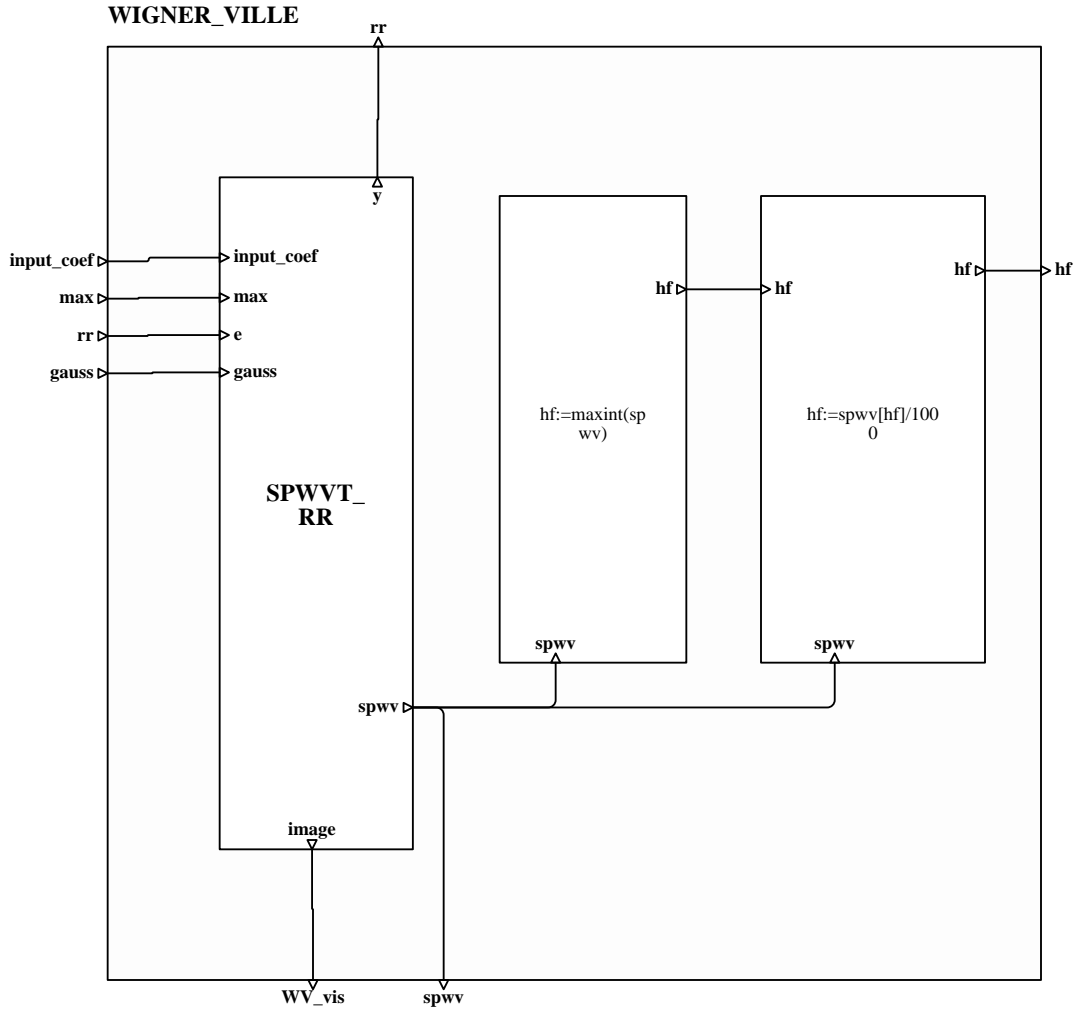


Process : WIGNER_VILLE

Comment

This process is used to extract the Heart Rate High frequency corresponding to the Respiratory Sinus Arrhythmia in *new-bor* new-borns.

Diagram



Process : modulesEcg/SPWVT_RR

Comment

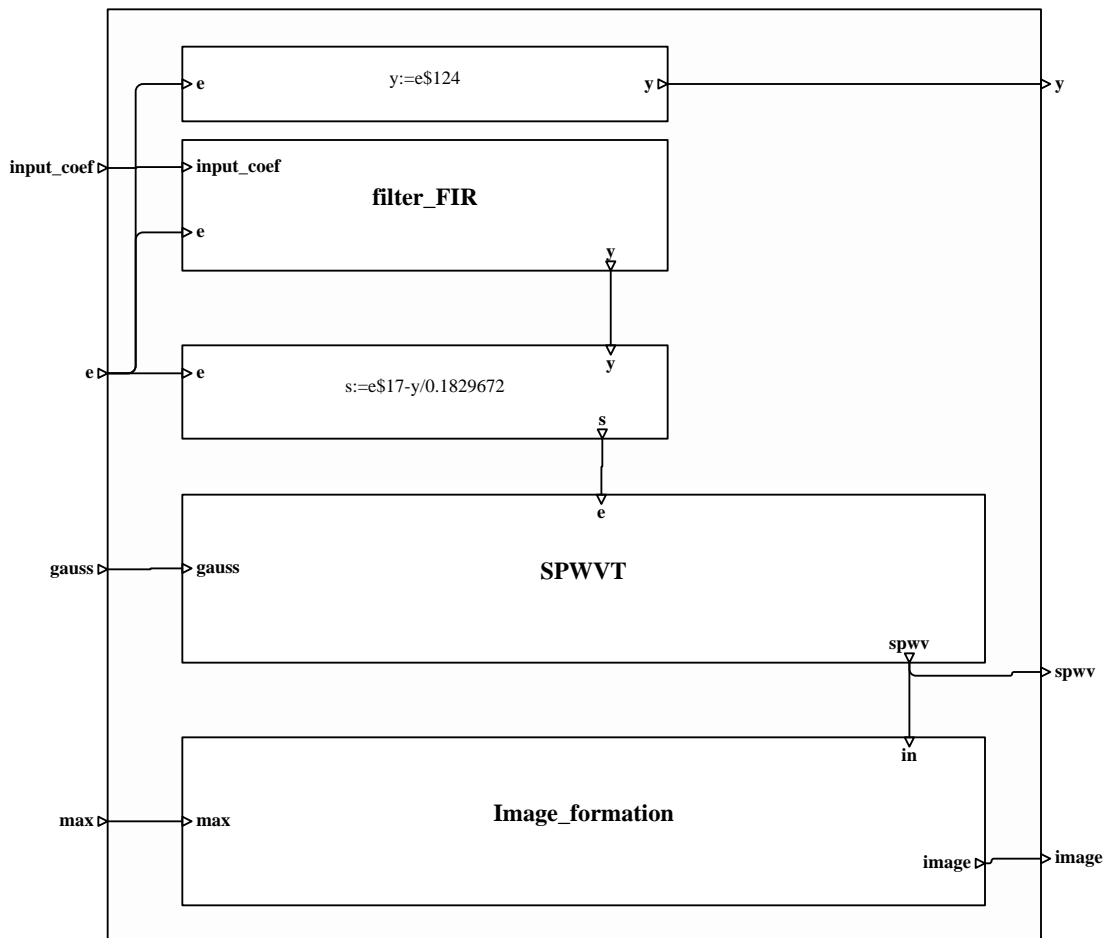
Smoothed Pseudo Wigner-Ville Transformation (temporal smoothing (16) rectangular window, frequencial smoothing (128) gaussian window (filename=gauss). The input signal is the resampled RR-signal at 2Hz. The signal is filtered to remove the low frequency component (filename=pb005). An time-frequency image is formed every 800 samples.

The delay between e and image is 124 samples: 17 for the filter and 107 for the SPWVT. the output y is synchronized with image.

To use this program with another frequency than 2Hz for the input signal, one must over-sample the input signal : for a RR signal resampled at 10Hz, it has to be over-sampling by 2 to obtain a 20Hz signal; it corresponds to the quickest frequency of the signal (5Hz for a 10Hzinput) multiplied by 4.

Diagram

SPWVT_RR



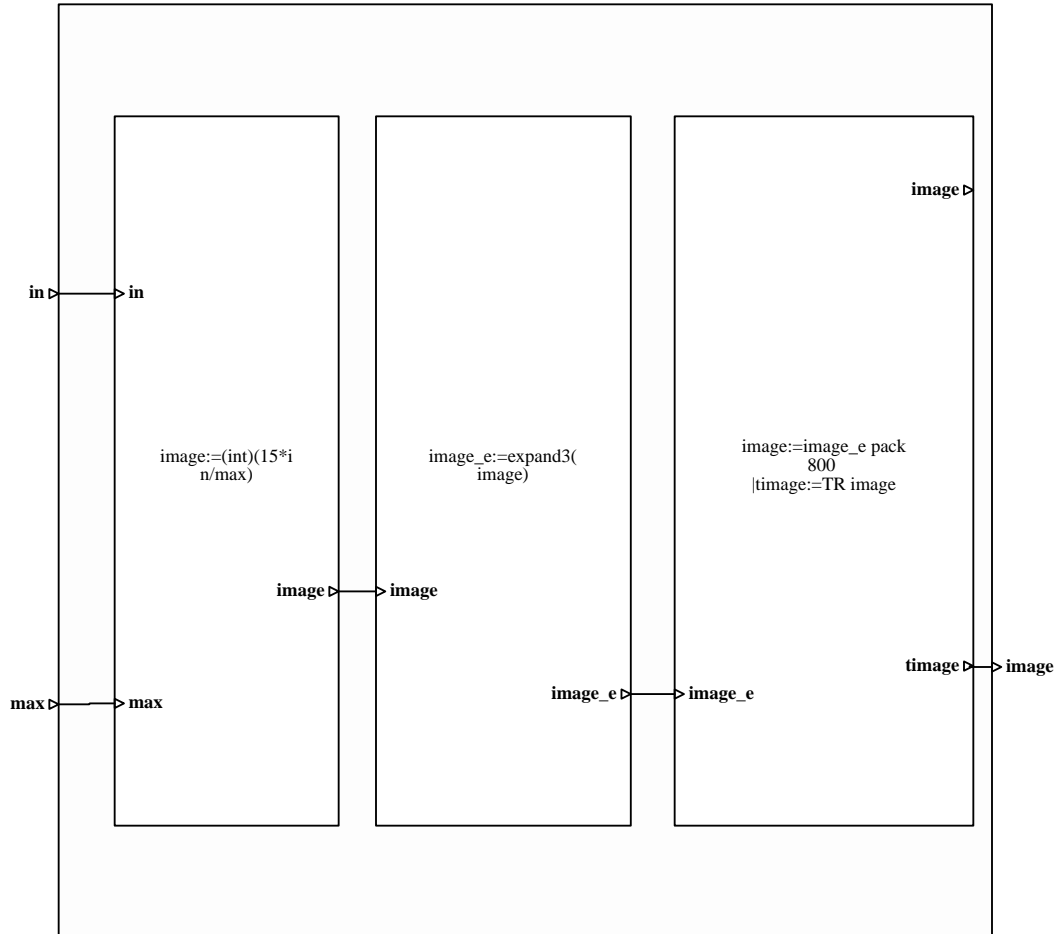
Process : modulesEcg/Image_formation

Comment

This module attributes to a matrix (e.g. resulting from a SPWVT) values from 0 to 15 (which correspond to a certain colour) and expands it by repeating the values of the rows. The result is 192 by 800 matrix. The max value has to be set to the maximum value that can be expected.

Diagram

Image_formation



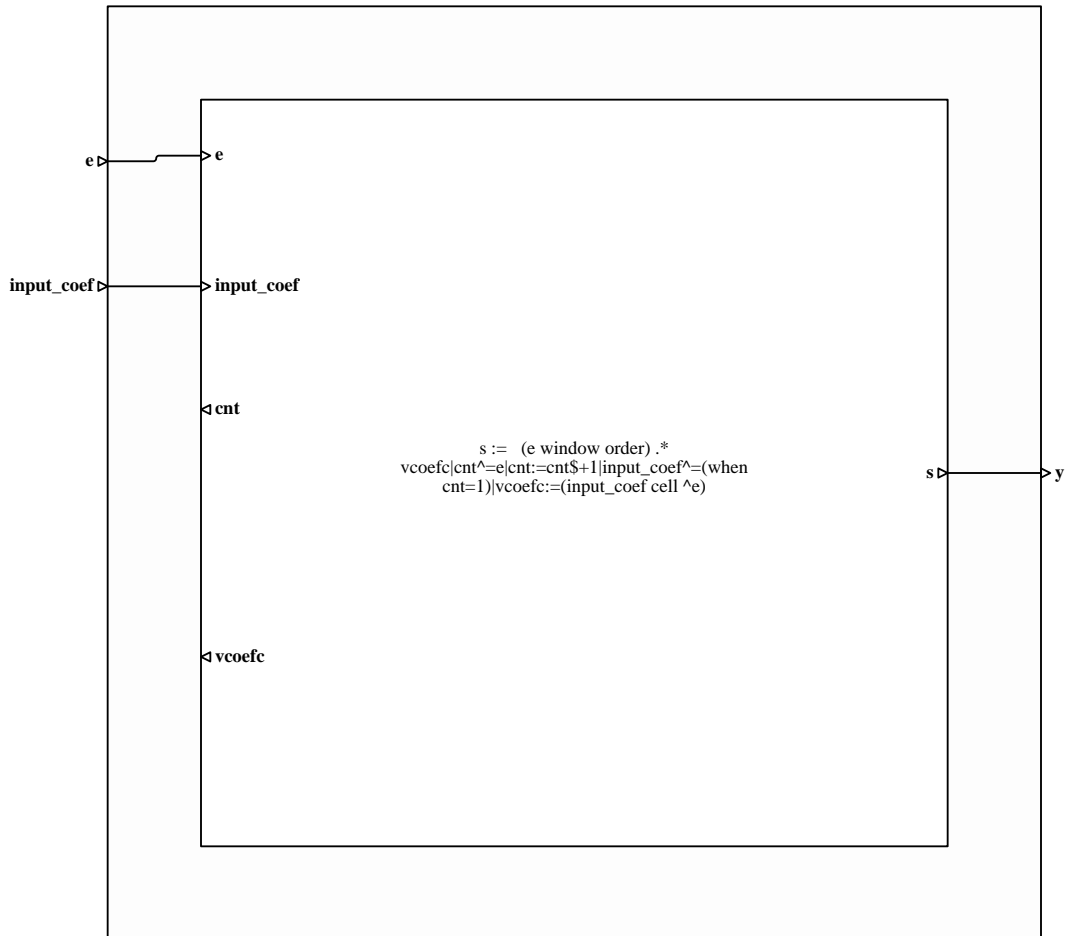
Process : filtres/filter_FIR

Comment

Finite Impulse Response filter of a programmable order. The input `input_coef` has to be connected to a file which contains the impulse response of the filter.

Diagram

filter_FIR



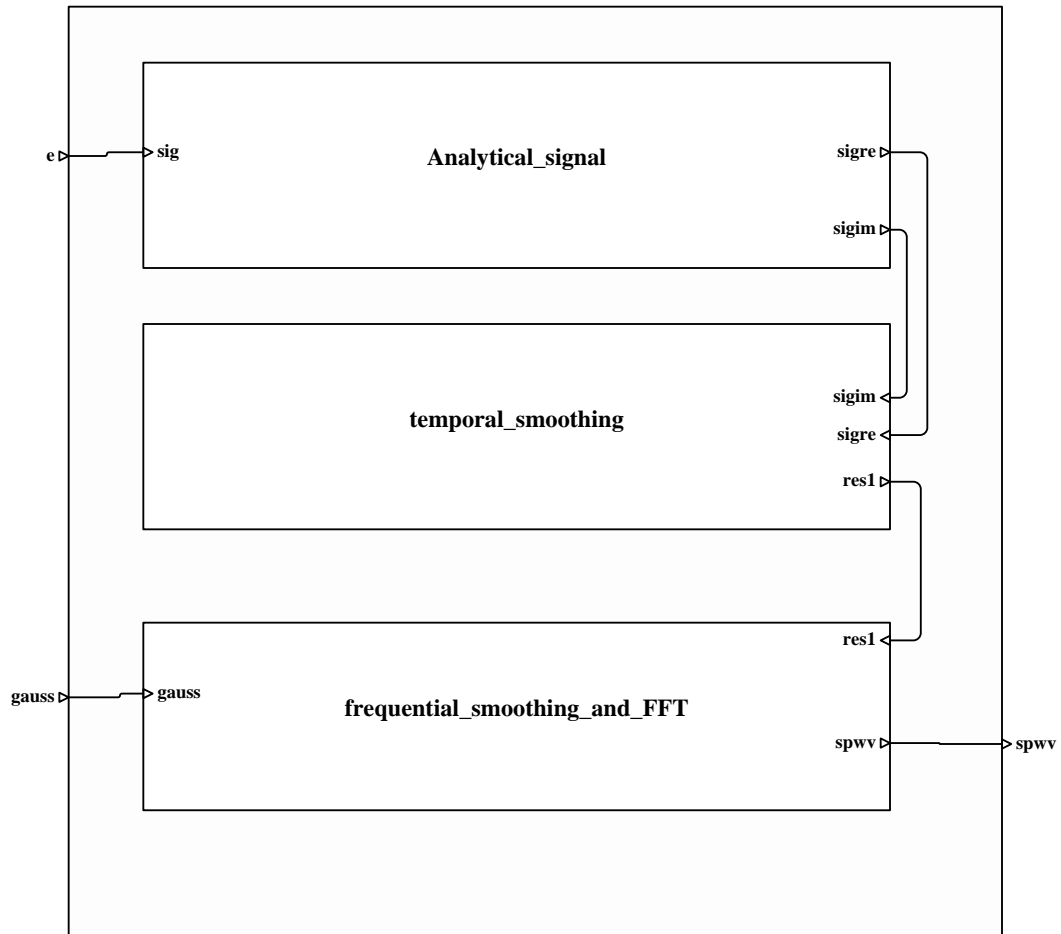
Process : modulesEcg/SPWVT

Comment

Smooth Pseudo Wigner Ville Transform, where the input is the analytical signal (computed on a signal with a limited frequency band (0.05 to 0.45))

Diagram

SPWVT

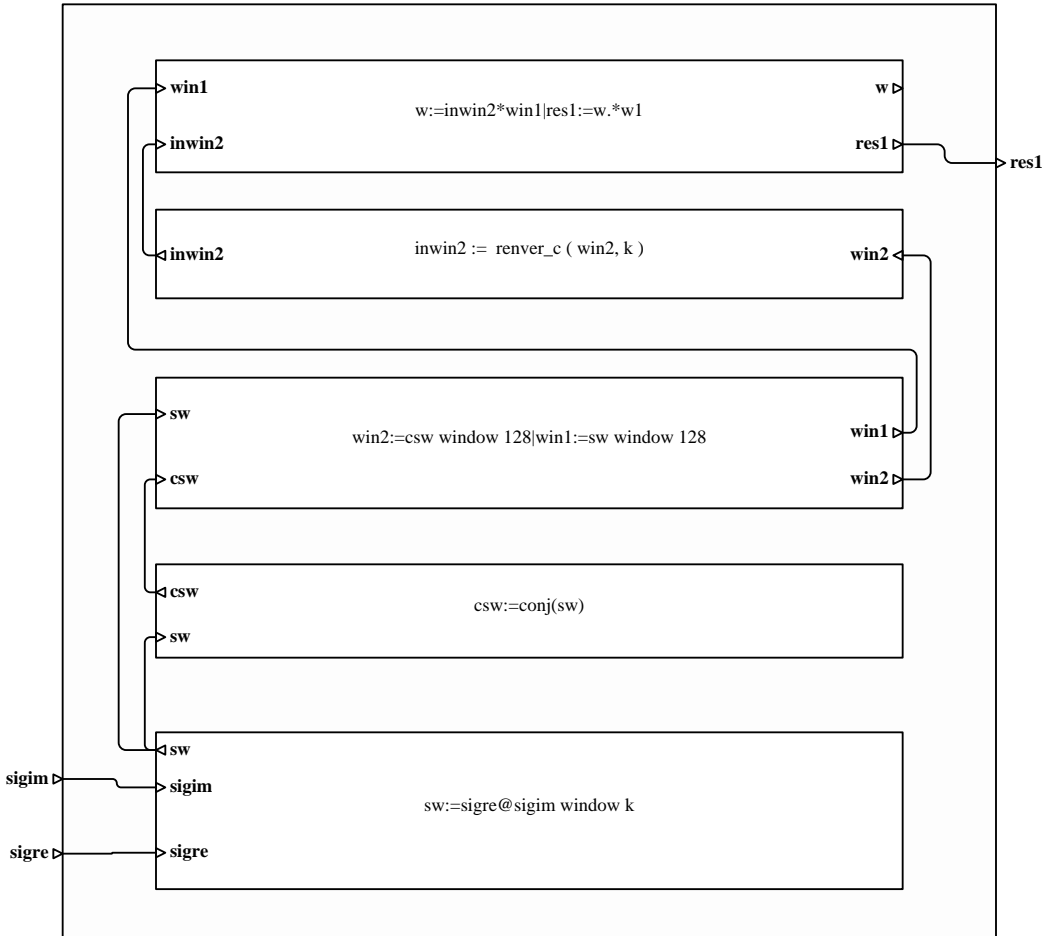


Process : temporal_smoothing

Comment

Diagram

temporal_smoothing

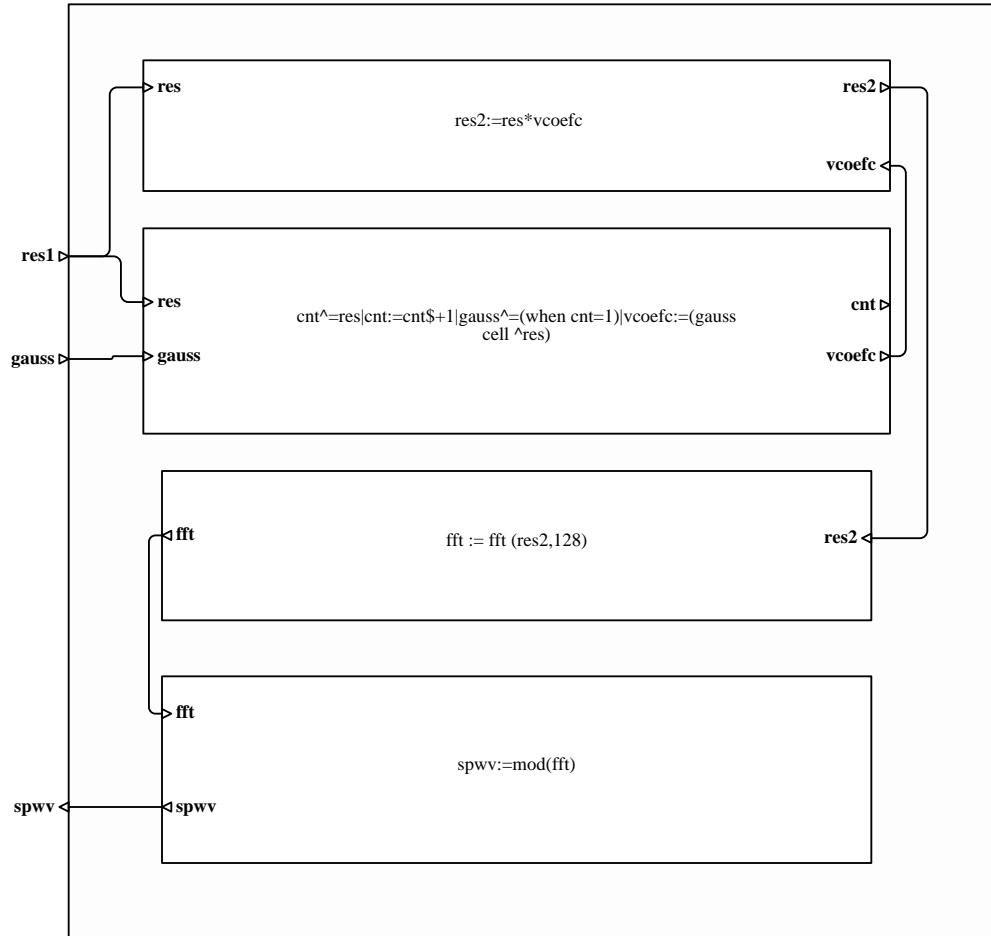


Process : frequential_smoothing_and_FFT

Comment

Diagram

frequential_smoothing_and_FFT



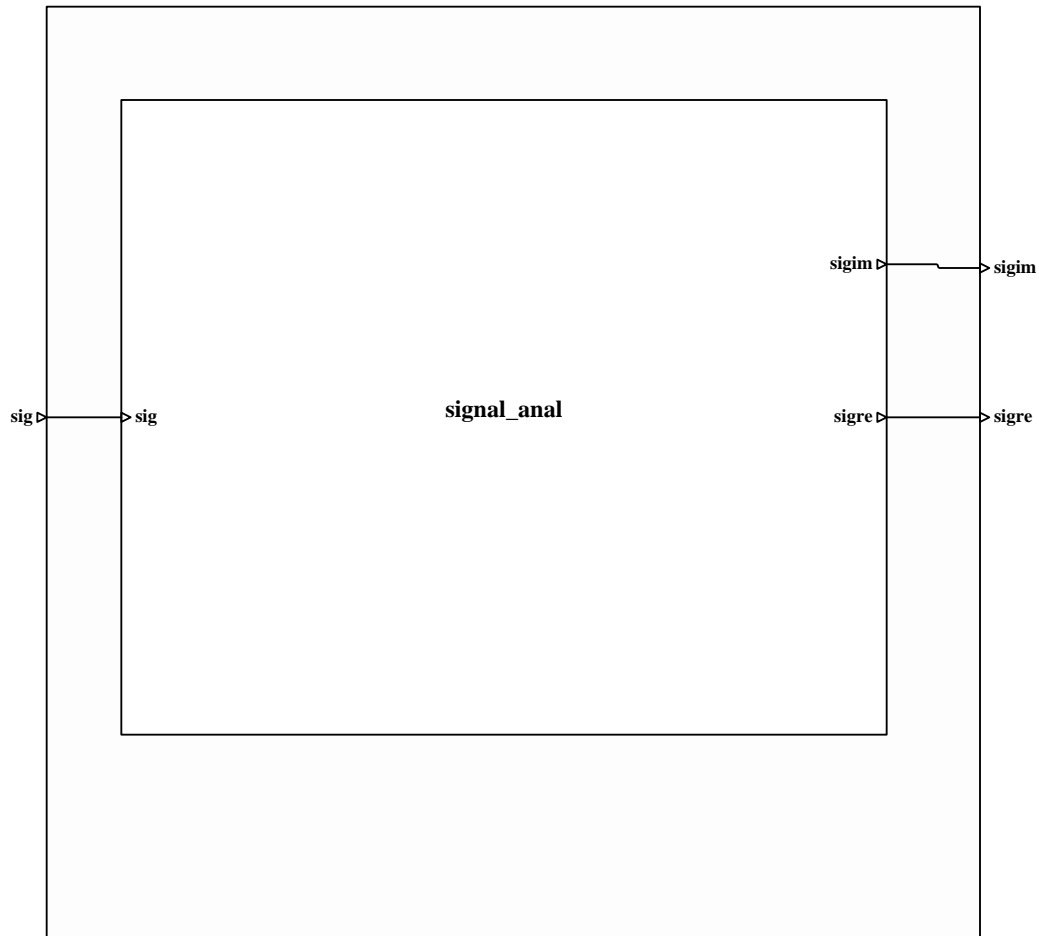
Process : modulesEcg/Analytical_signal

Comment

Module that calculates the analytical signal, based on a FIR-filter to compute the imaginary part (dephasing of 90 degrees). π
The domain where the filter is applicable is [0.01 0.49] normalised frequency. The maximum error is 2.9 percent.

Diagram

Analytical_signal

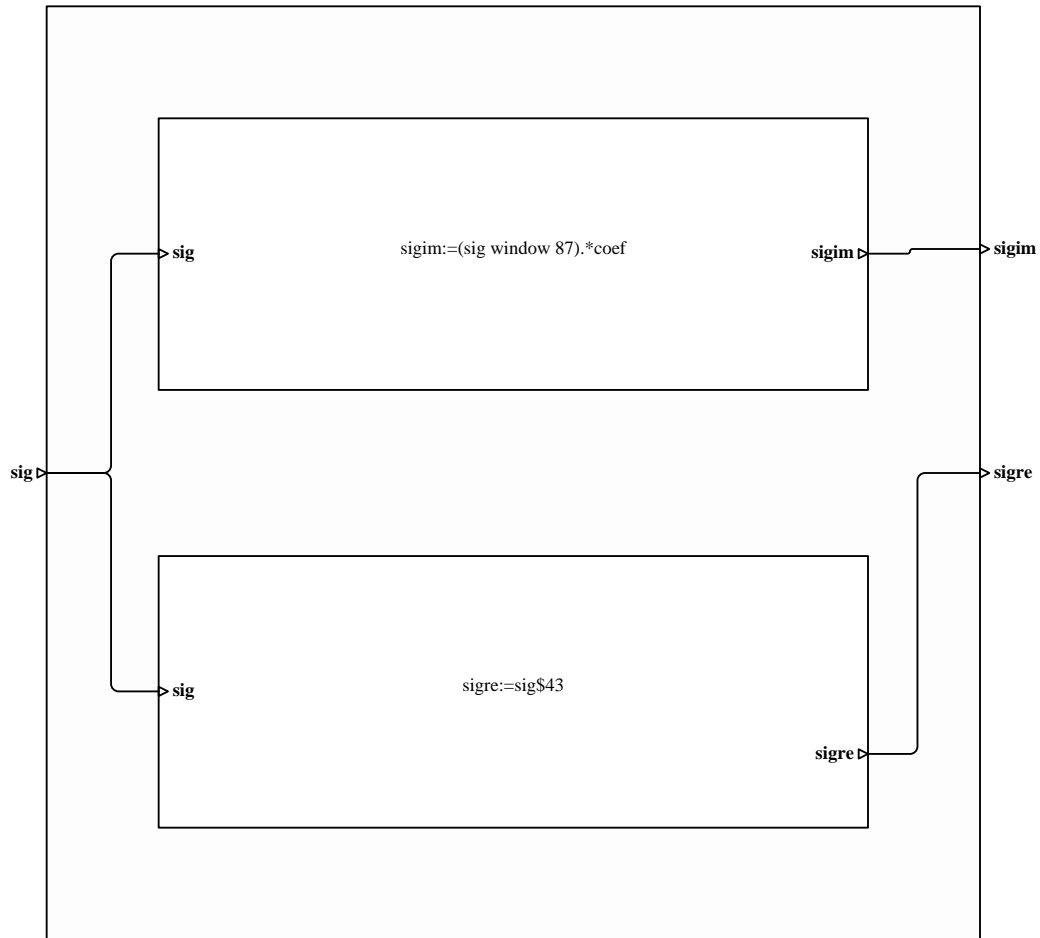


Process : signal_anal

Comment

Diagram

signal_anal



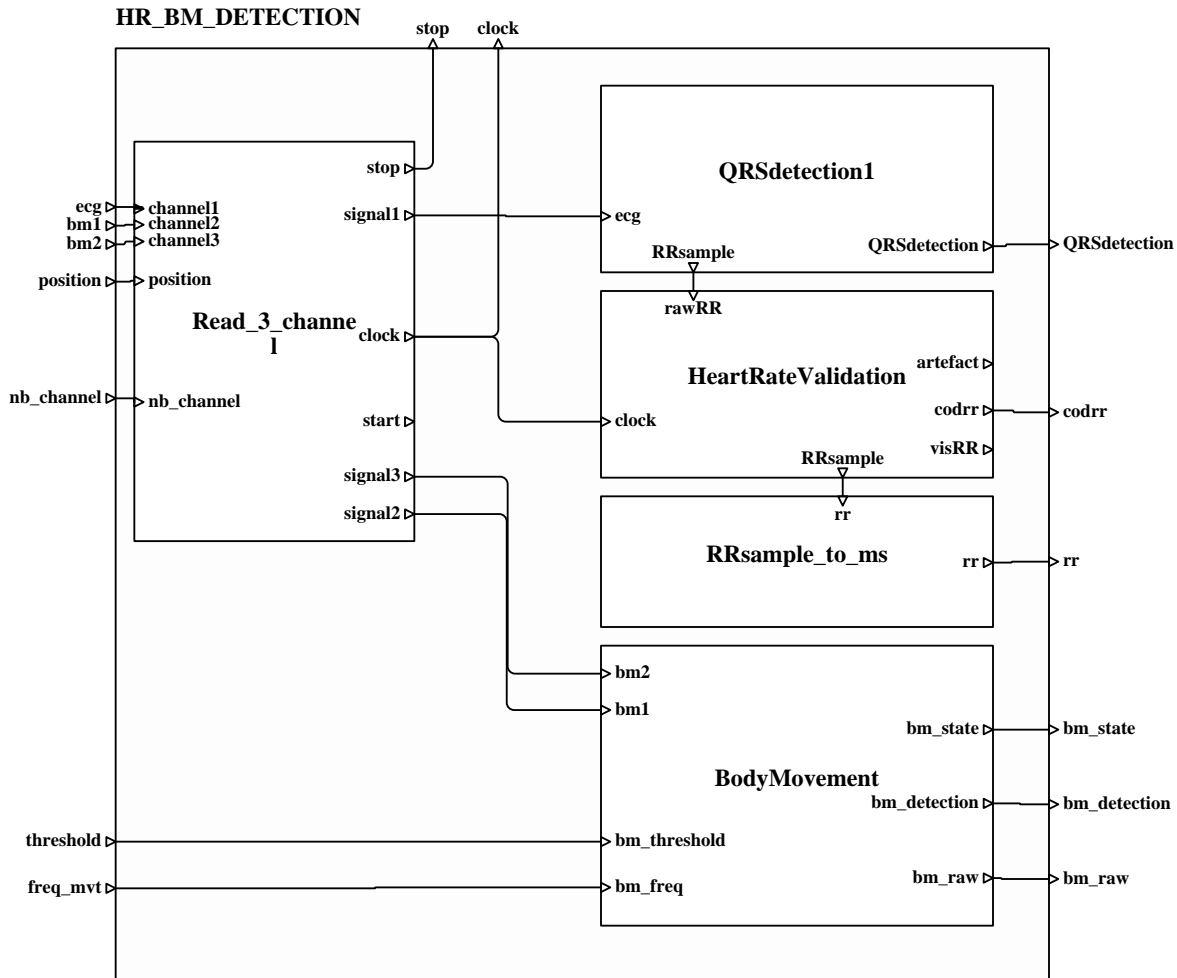
Process : HR_BM_DETECTION

Comment

This process is used for the detections on the raw signals:

- RR intervals from the ECG
- Body Movements occurrences from the body movement channel.

Diagram



Process : modulesEcg/Read_3_channel

Comment

This program is used for the reading of 3 channels from a binary multi_channels file with a direct access.

*Input:

- position: file position in number of samples; this signal which is connected to a gauge in the SIGNAL program, can be `mov` moved dynamically during the execution.

- nb_channel: number of channels in the file.

- channel1, channel2, channels3: channels chosen number

*output:

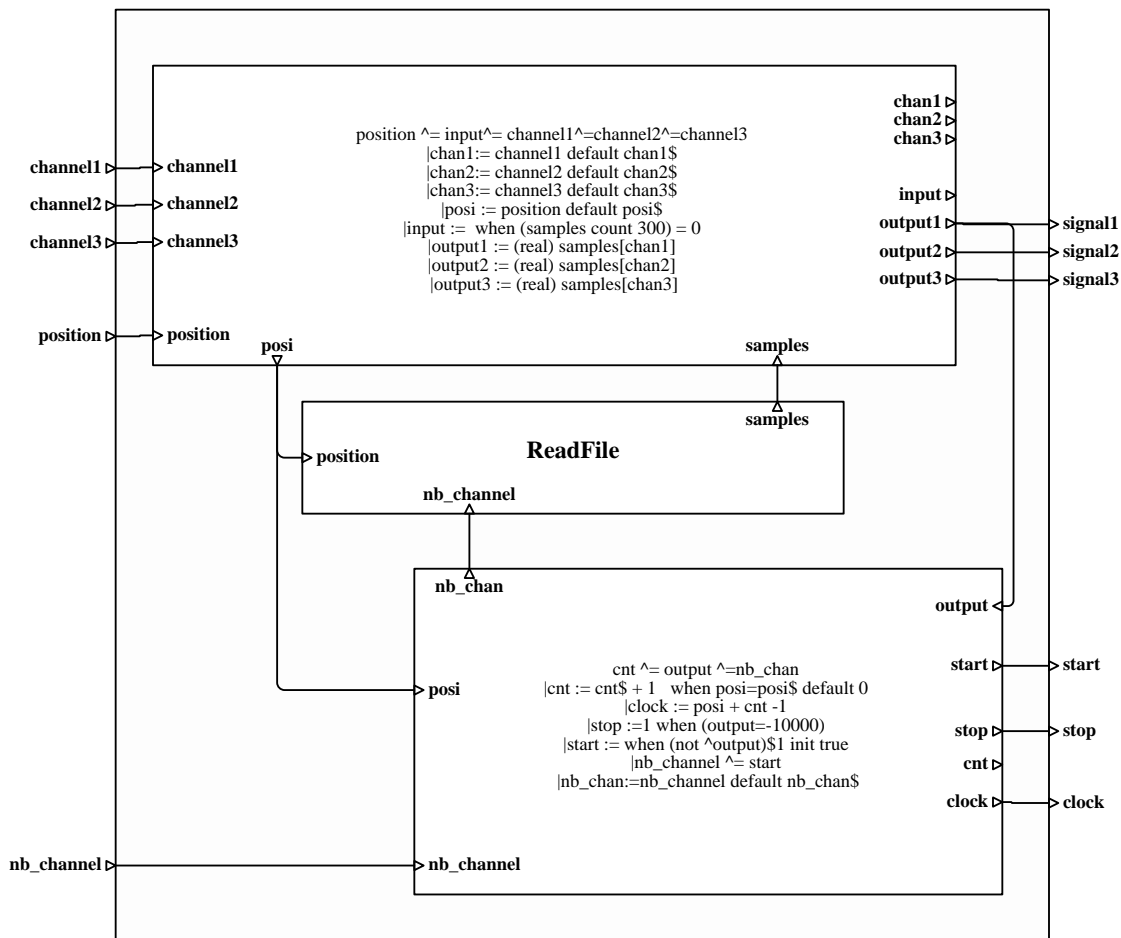
- signal: the extracted signal, in a real type.

- clock: counter of the signal samples read, synchronous with it

- start and stop: particular events, synchronous with the first and the last occurrences of the signal.

Diagram

Read_3_channel



Process : modulesEcg/QRSDetection1

Comment

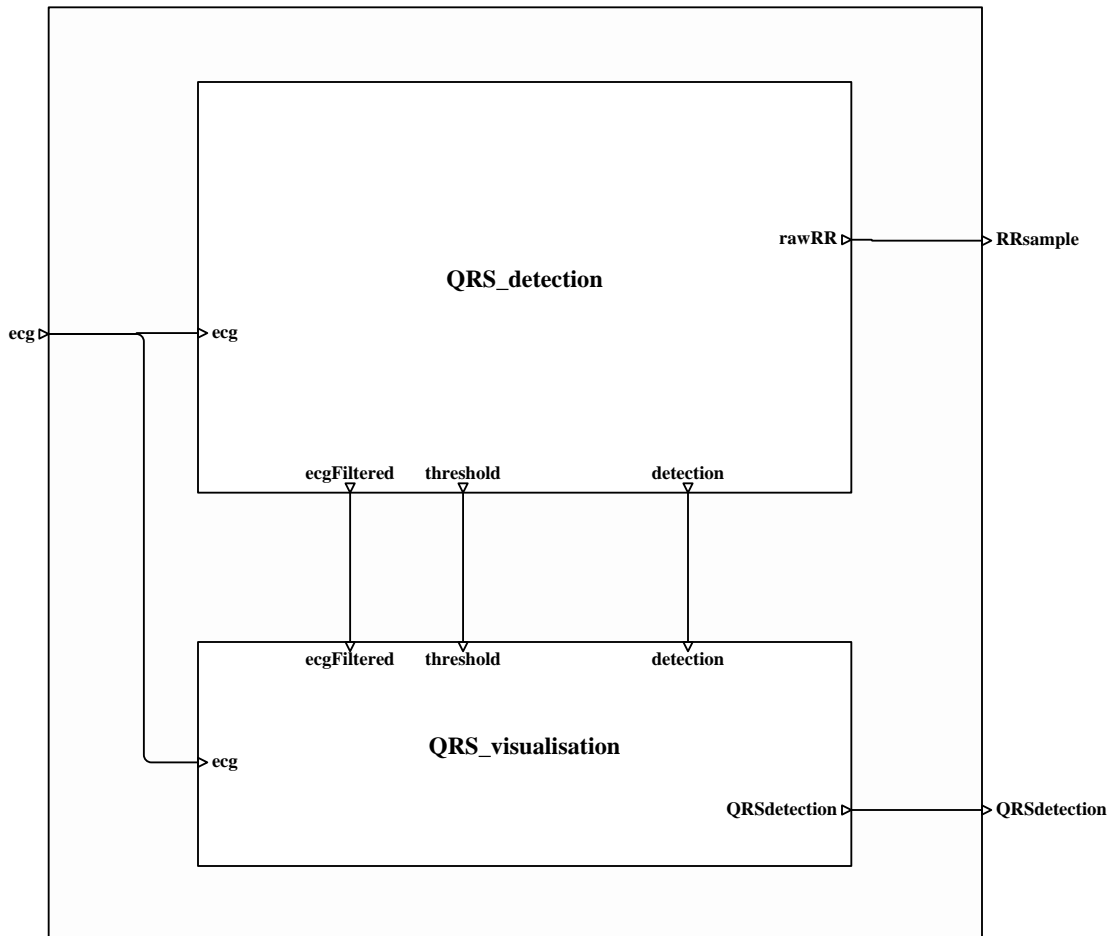
Algorithm calculating the cardiac rhythm starting from the ECG-signal, using an adaptive FIR-filter.

The initial form of the FIR-filter looks like an QRS-complex.

After the detection of a QRS-complex (when the filter template matches with the signal and the resulting filtered signal passes a certain adaptive threshold), the filter response is recalculated using a certain percentage of the old filter response and a certain percentage (convergence factor) of the detected QRS-complex. This new filter response is recentered to avoid that the response derives.

Diagram

QRSDetection1

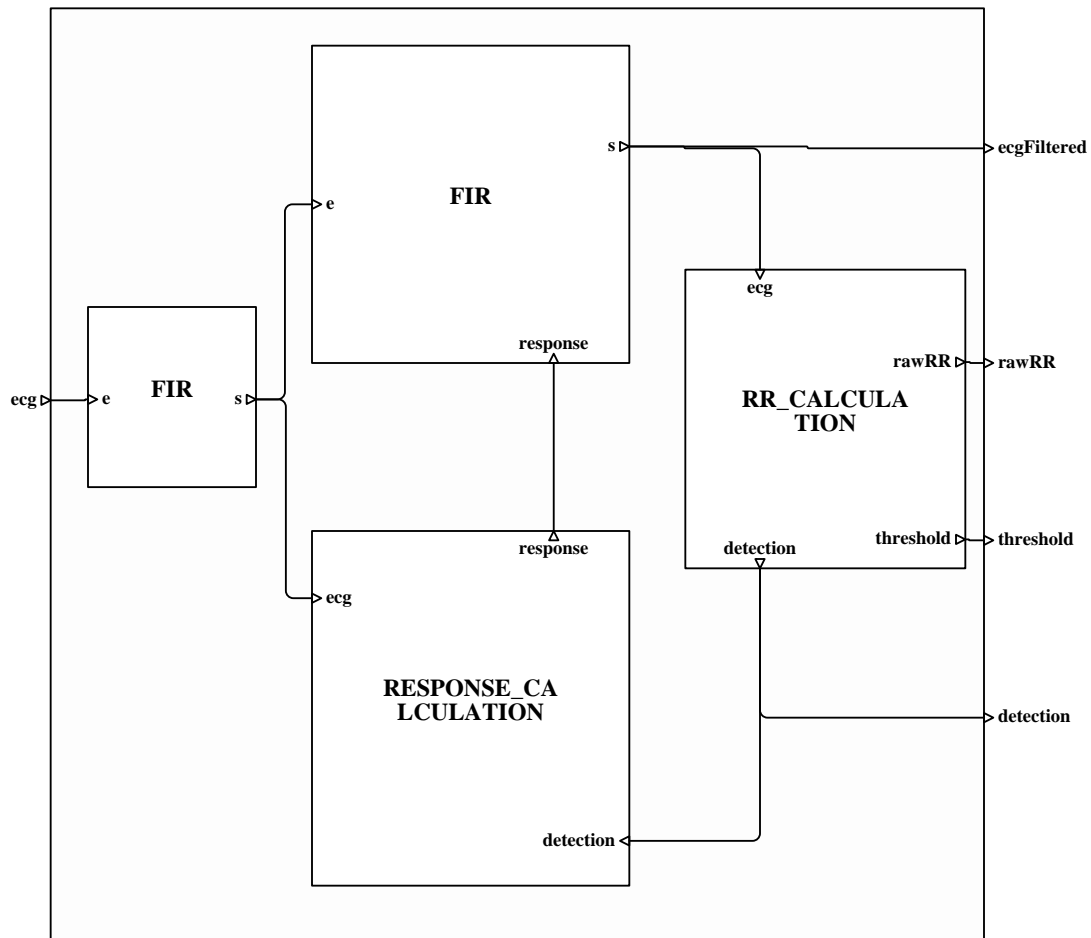


Process : QRS_detection

Comment

Diagram

QRS_detection

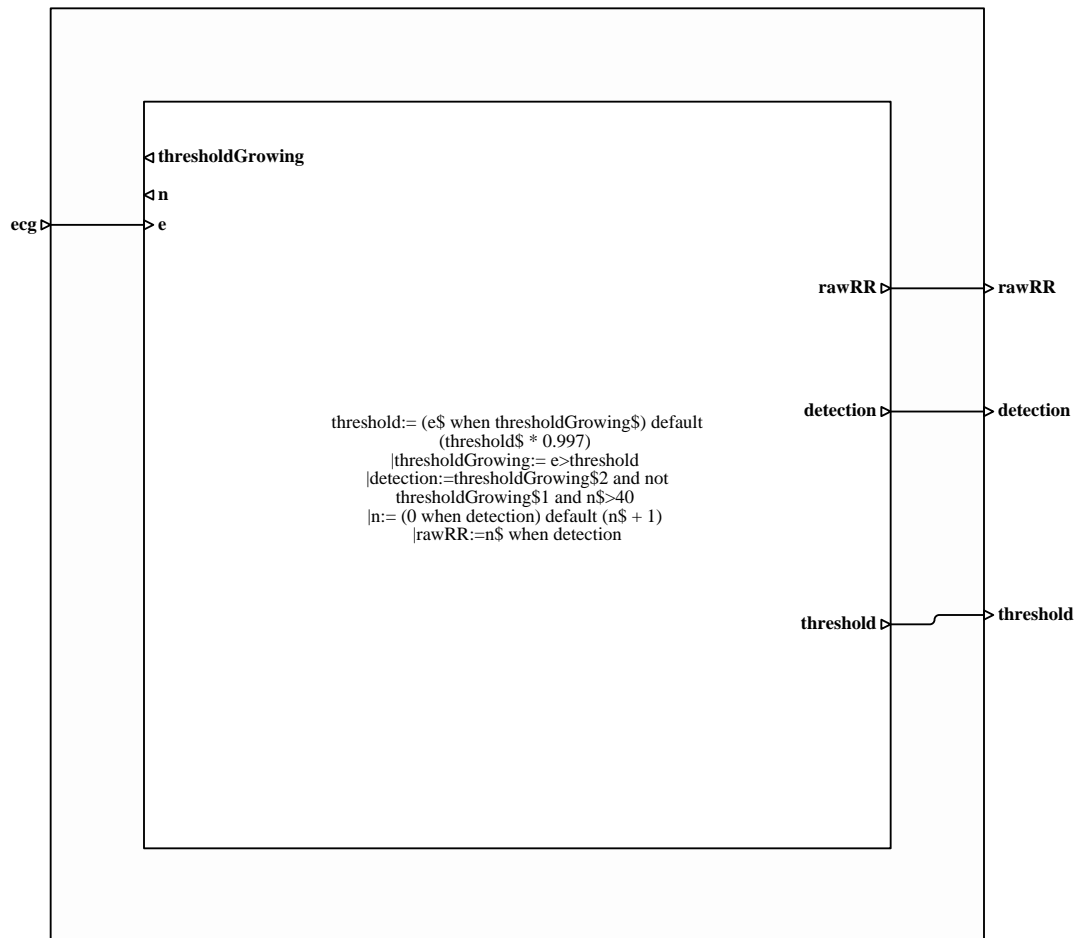


Process : RR_CALCULATION

Comment

Diagram

RR_CALCULATION

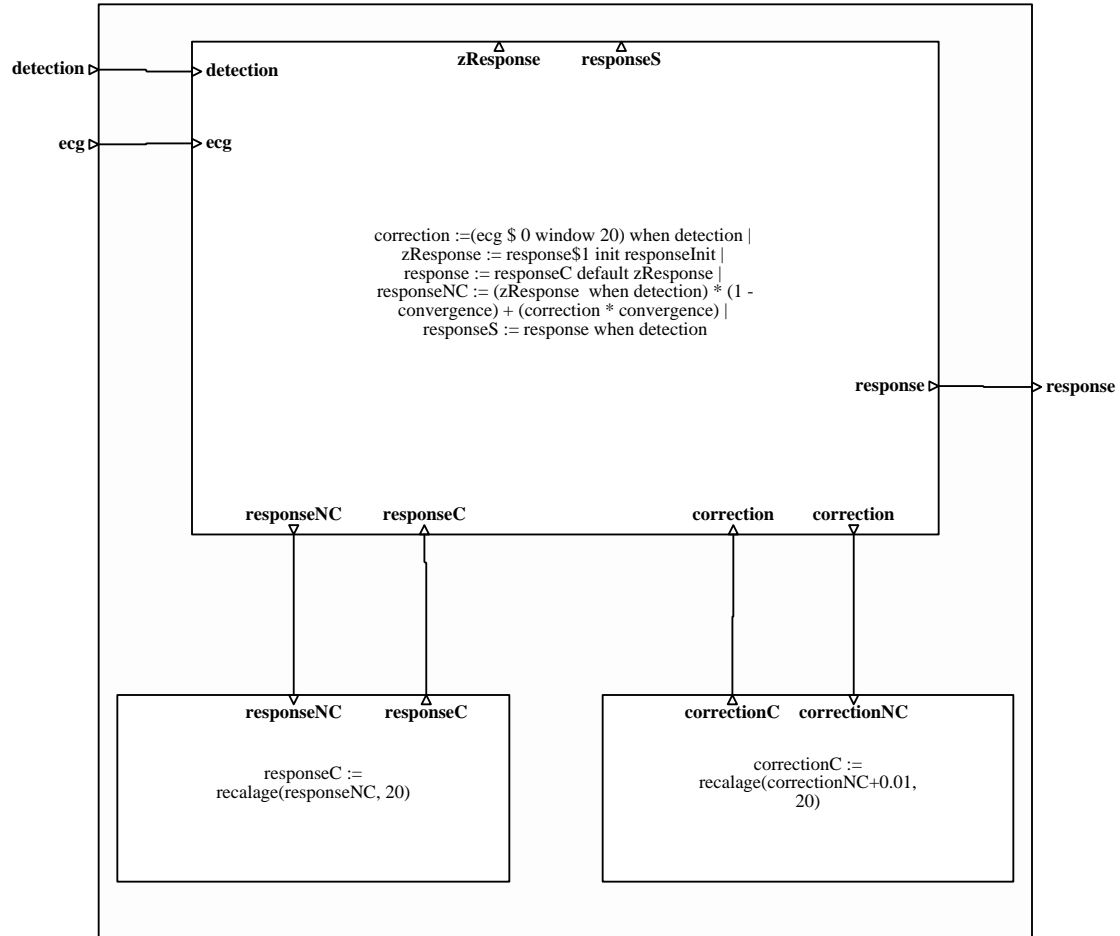


Process : RESPONSE_CALCULATION

Comment

Diagram

RESPONSE_CALCULATION



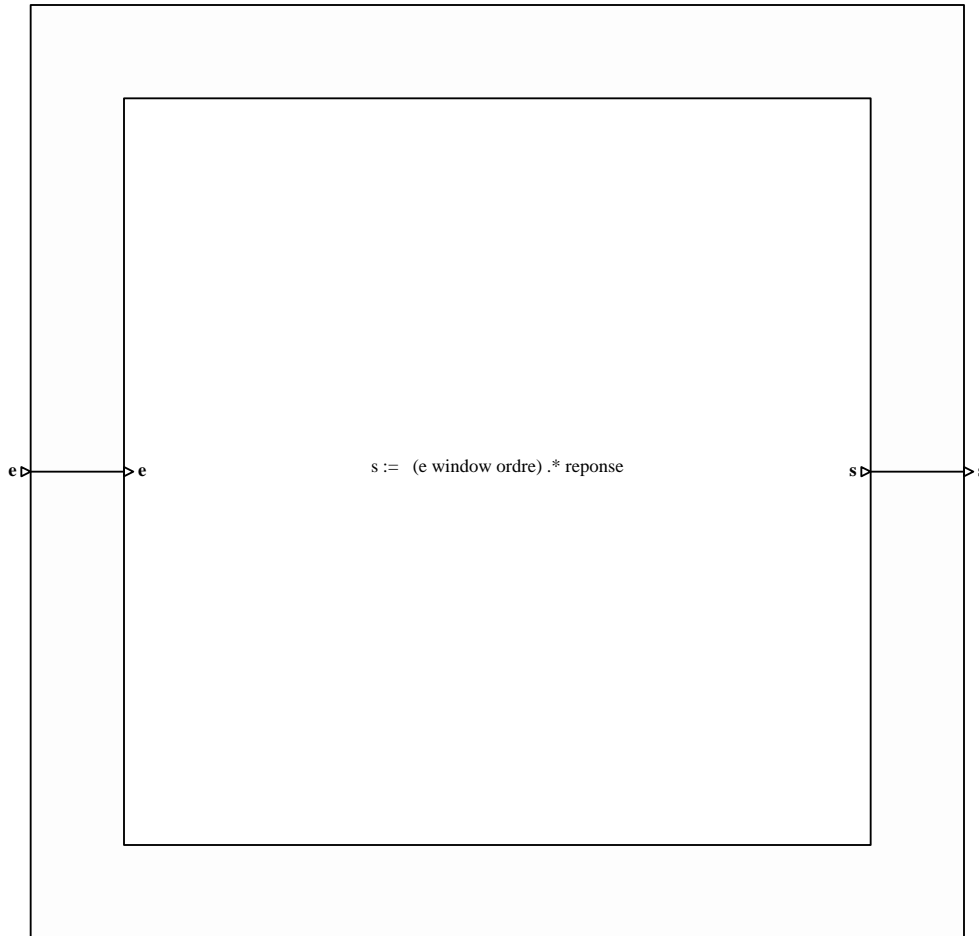
Process : filtres/FIR

Comment

Finite Impulse Response filter

Diagram

FIR



Process : modulesEcg/BodyMovement

Comment

This program is used to the Body Movements detection :

*Input:

- bm1,bm2: channels numbers of the upper and lower limbs
- bm_freq: cut-off frequency of the first order high pass filter
- bm_threshold: Body Movements detection threshold

*Output:

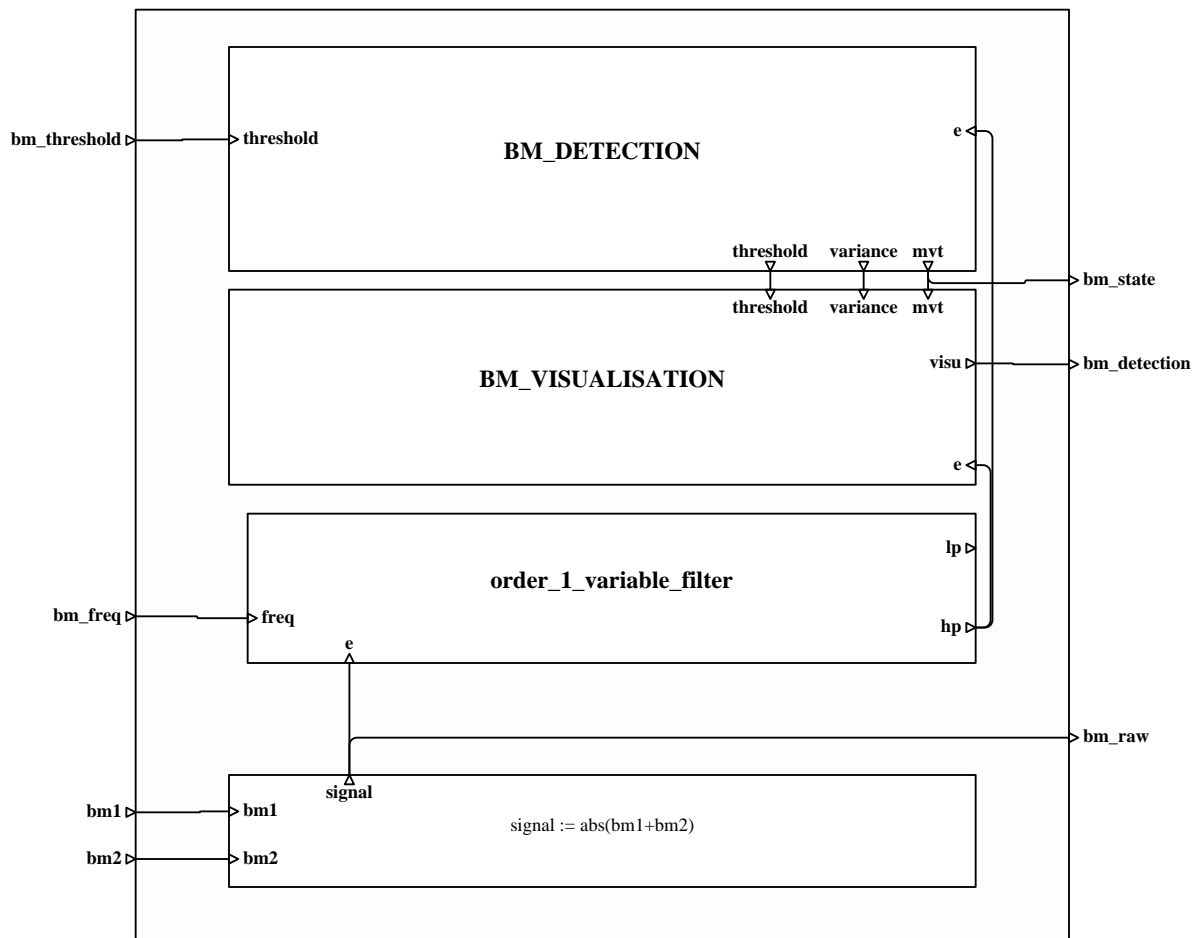
- bm_raw: Body Movements raw channel
- bm_state: boolean signal, synchronous with the Body Movements raw signal, true when there is a movement, default false
- bm_detection: visualisation of the raw, filtered, threshold and bm_state signals used for the detection; it's allows a *dynamic* dynamical adjustment of the method parameters (bm_frequency and bm_threshold)

*Description:

At first, a high pass filter is used to cut the respiratory oscillations , possible when the upper limb is posed on the thorax; then then the detection uses a threshold, connected to a gauge and applied to the filtered Body Movement signal (short terme *varia* variance); the resulting signal is the boolean bm_state signal.

Diagram

BodyMovement



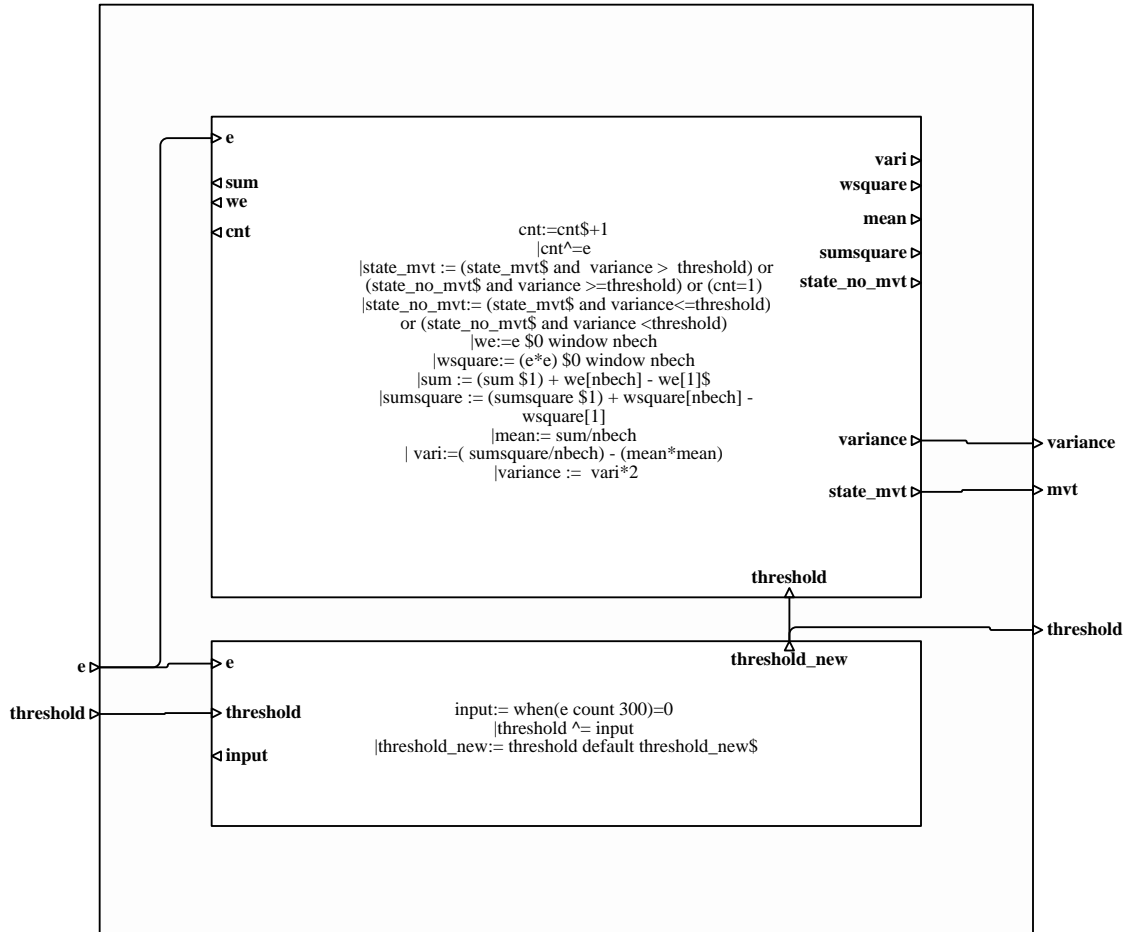
Process : BM_DETECTION

Comment

The detection uses a threshold, connected to a gauge and applied to the filtered Body Movement signal (short term *variance* variance); the resulting signal is the boolean *bm_state* signal.

Diagram

BM_DETECTION



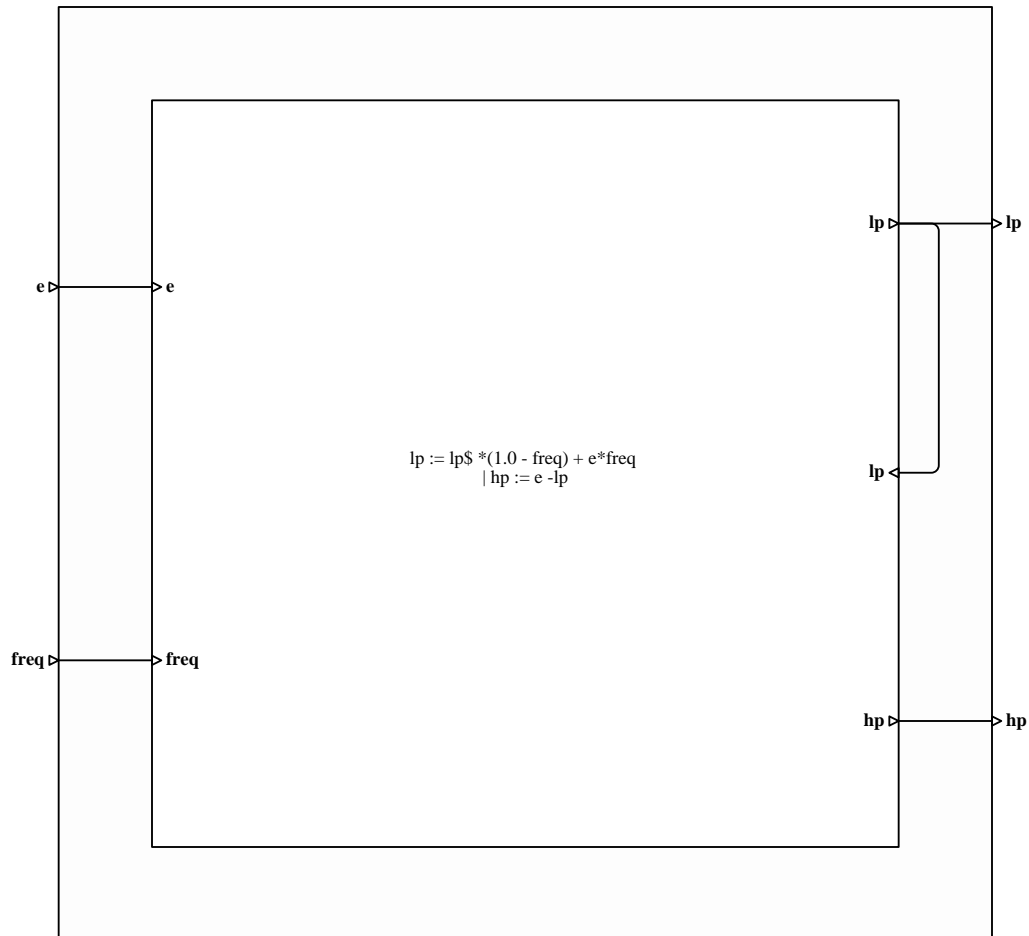
Process : filtres/order_1_variable_filter

Comment

First order low pass and high pass filter. Freq is the normalised variable cut-off frequency parameter.

Diagram

order_1_variable_filter



Process : STATISTICS

Comment

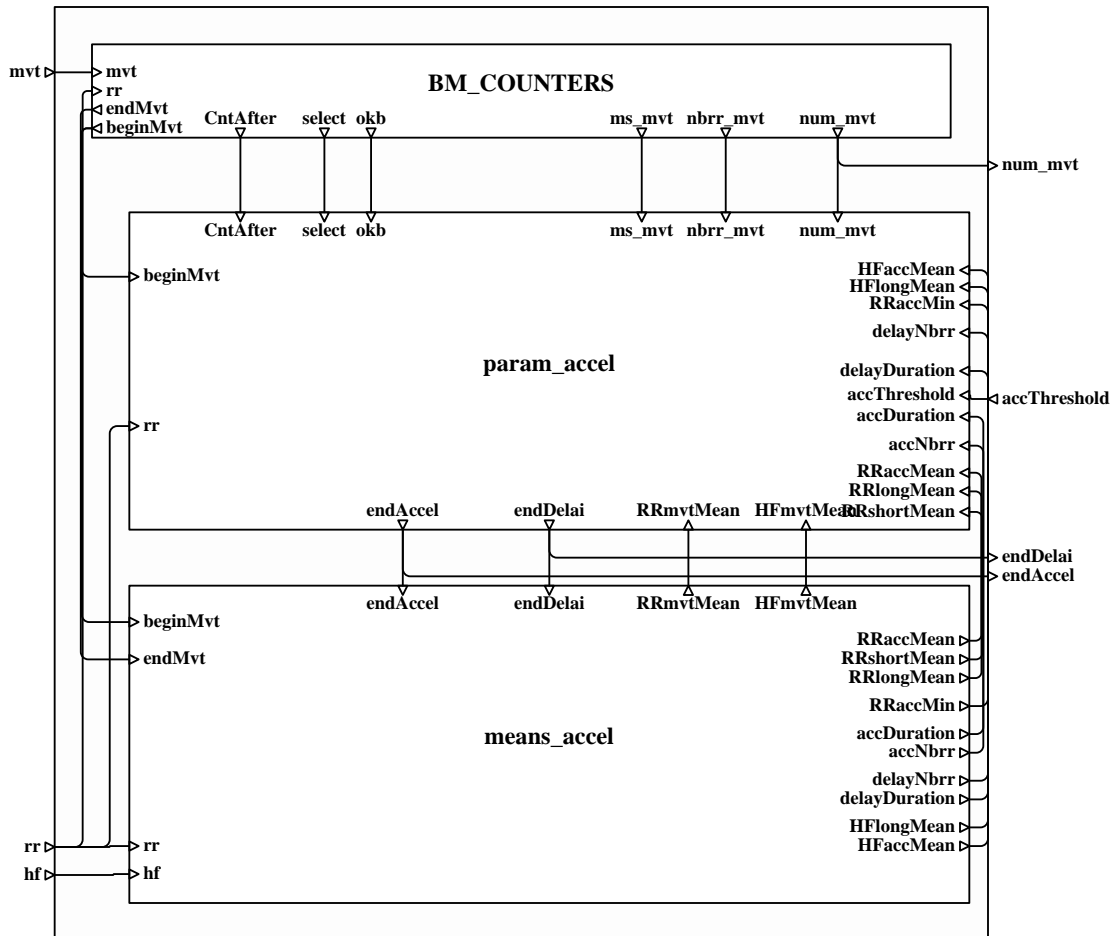
Computation of elementary statistics on the Heart Rate variables: RR and High Frequency .

These statistics are made over the epochs of physiological interest for this application, i.e. the epochs related to Body Movements:

we consider the epochs before movements (control epochs), epochs during and after acceleration. Such epochs are automatically determined : the beginning and the end of accelerations are detected by a threshold applied on a sliding mean of the Heart Rate.

Diagram

STATISTICS

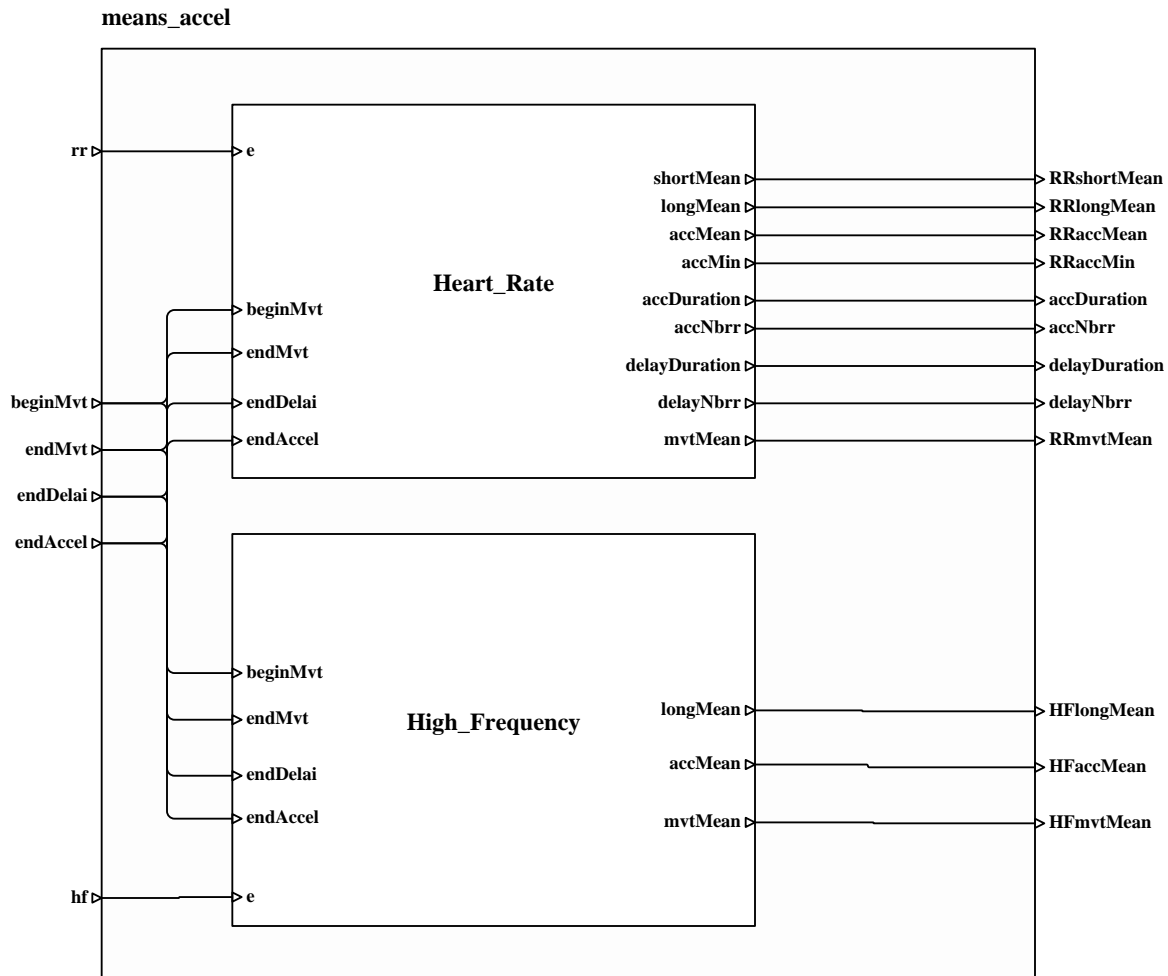


Process : means_accel

Comment

This process generates the statistical parameters for each the Heart Rate (RR) signal and the High Frequency (hf) signal; The input signals are the instants which define the beginnings and ends of the statistical units.

Diagram

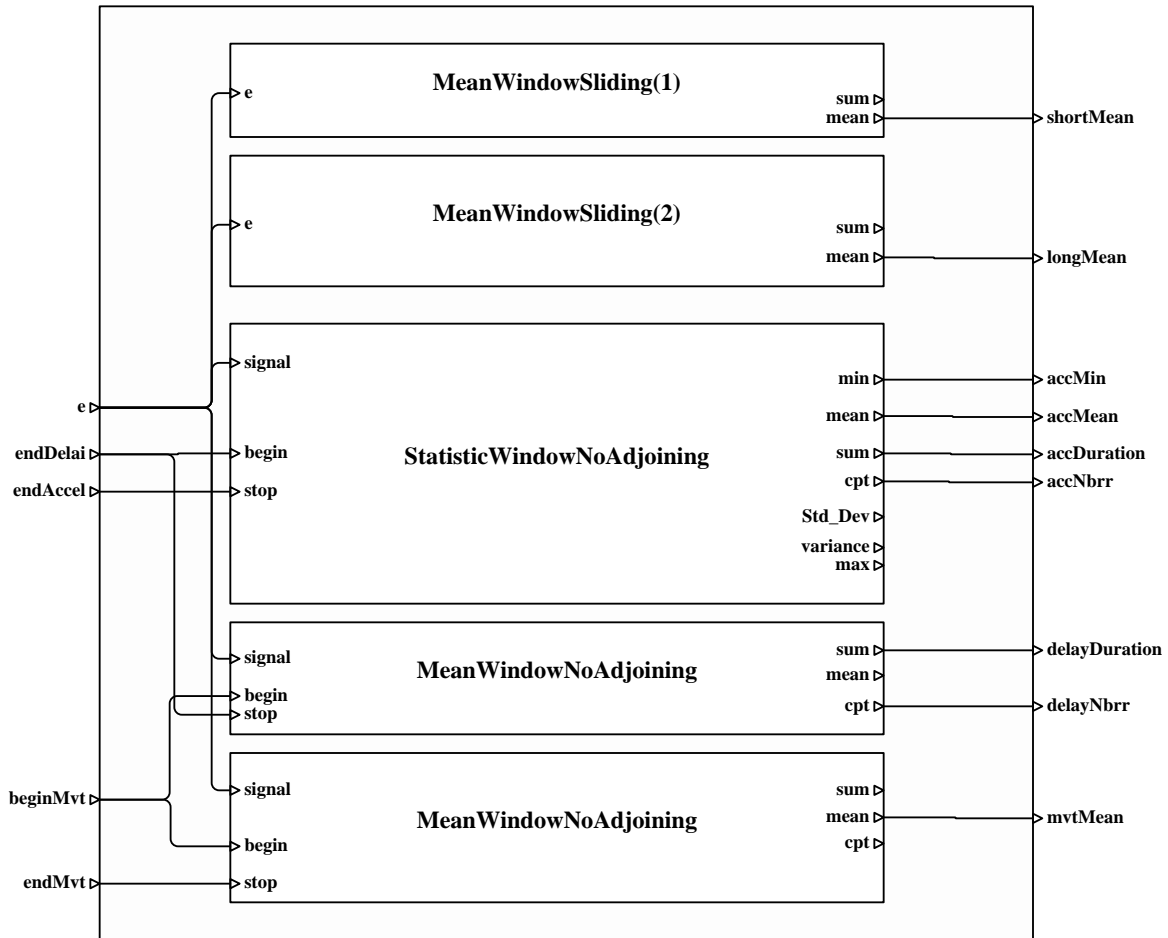


Process : Heart_Rate

Comment

Diagram

Heart_Rate



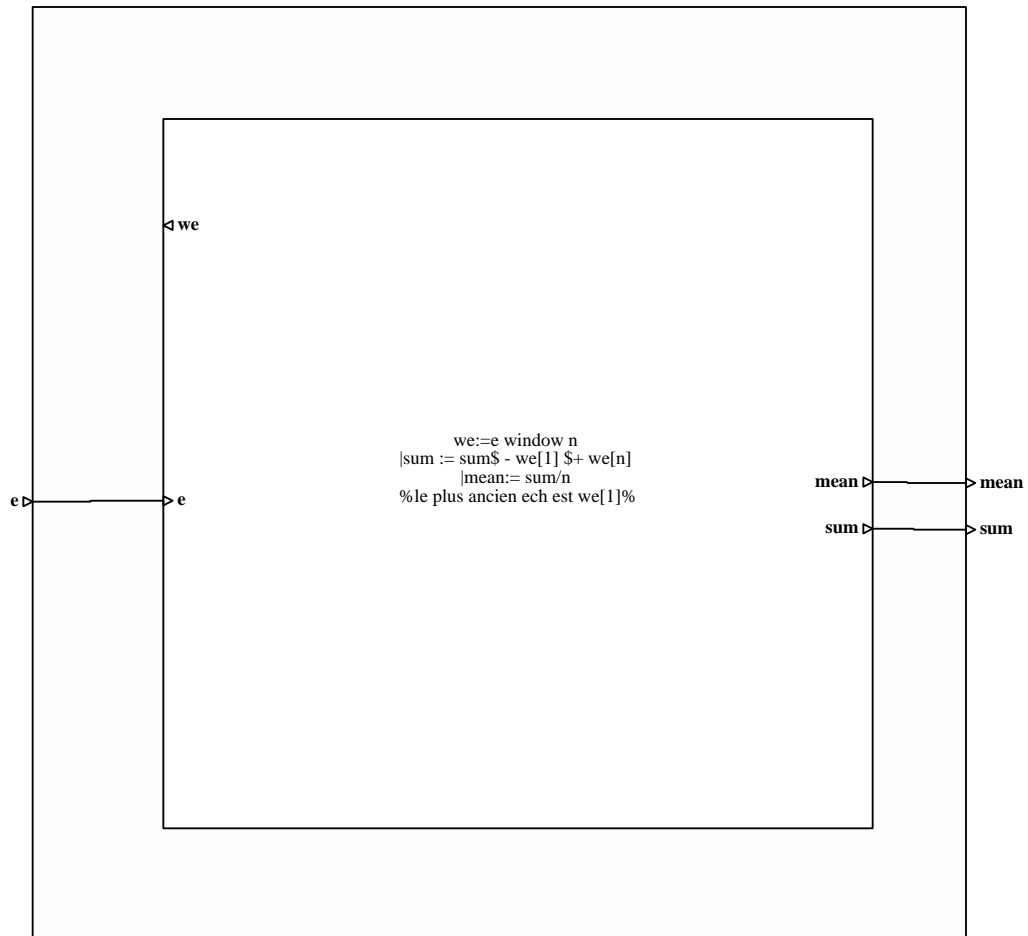
Process : modulesEcg/MeanWindowSliding

Comment

Mean and sum are computed on sliding windows. The input signal is of a real type.

Diagram

MeanWindowSliding



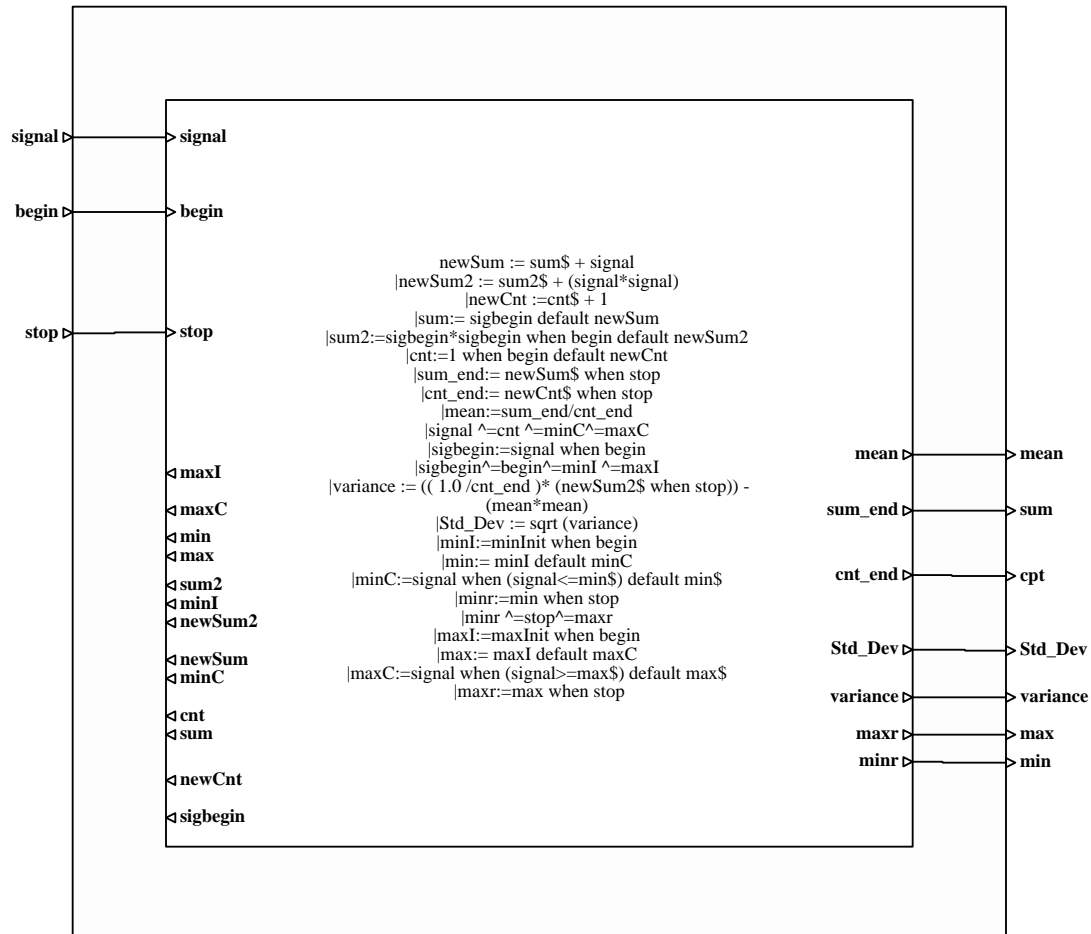
Process : modulesEcg/StatisticWindowNoAdjoining

Comment

Elementary statistics computed by adjoining epochs: these epochs can have a variable size: their length is determined by the occurrences of the 'begin' and 'stop' events .

Diagram

StatisticWindowNoAdjoining



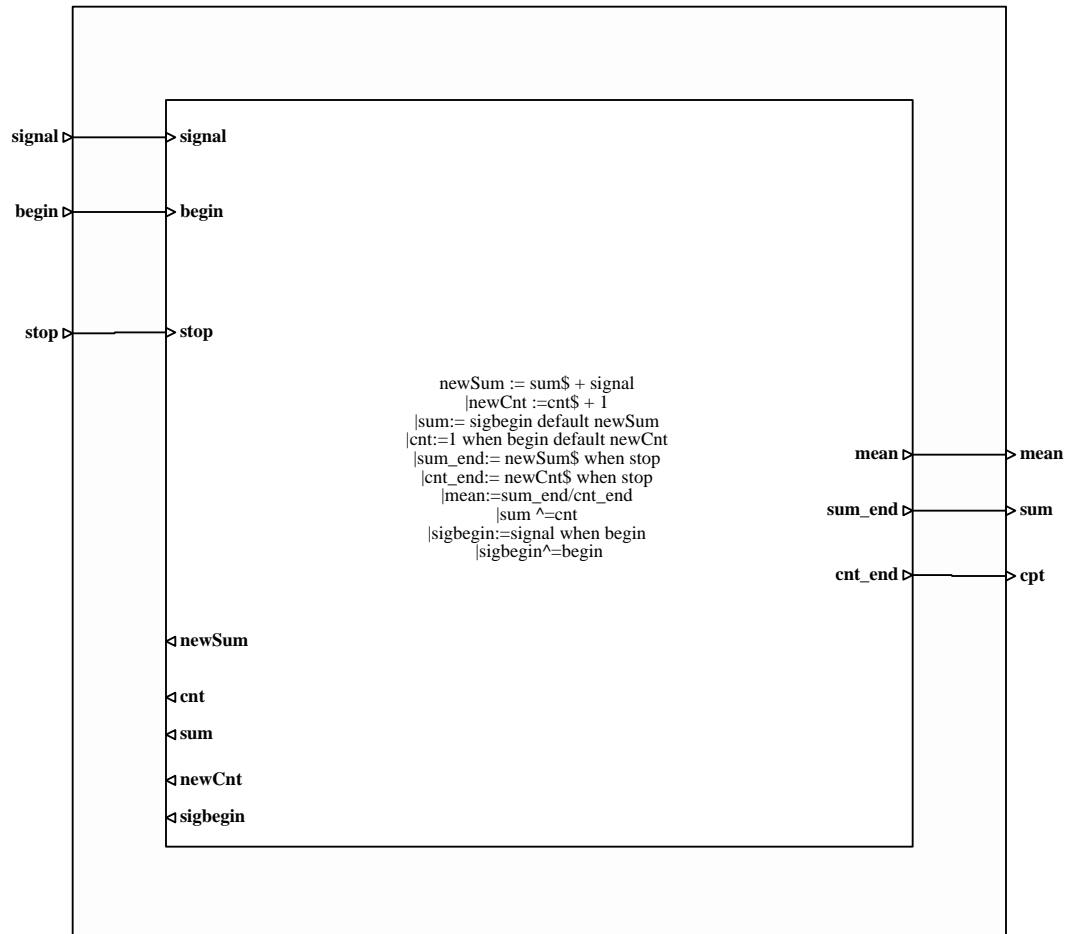
Process : modulesEcg/MeanWindowNoAdjoining

Comment

Elementary statistics computed by adjoining epochs: these epochs can have a variable size: their length is determined by the occurrences of the 'begin' and 'stop' events .

Diagram

MeanWindowNoAdjoining



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