

ESGCO 2022 challenge: documentation file

Title of the challenge

Characterizing cardiorespiratory interactions from spontaneous fluctuations of heart period and respiratory flow during controlled breathing

Description of the challenge

The participants to the challenge are required to characterize cardiorespiratory interactions from the spontaneous fluctuations of heart period and respiratory flow during spontaneous breathing and controlled respiration at different respiratory rates in healthy subjects. The aim is to gain insight on the dependence of cardiorespiratory coupling on the breathing rate. Characterization could be carried out in any domain (i.e., time, frequency, and information domain) using any tool or metric that it is deemed to be helpful in assessing cardiorespiratory control and its evolution with the breathing rate.

Description of the experimental protocol and variability series

Data belong to a historical database devoted to the assessment of the cardiac control in healthy subjects [1,2]. Briefly, data were acquired from 19 healthy subjects (age: 27-35 yrs, median = 31 yrs; 11 females and 8 males) at rest in supine position during spontaneous respiration and paced breathing at different respiratory rates (i.e. 10, 15 and 20 breaths/minute). The period of spontaneous respiration preceded always paced breathing. Controlled breathing sessions were carried out in random order. The timing of inspiratory and expiratory onset was provided via a metronome and reinforced verbally by the experimenter. The subjects were not allowed to talk during the entire protocol. Electrocardiogram (ECG) from lead II and respiratory flow via a nasal thermistor were acquired at 300 Hz. The respiratory flow signal was uncalibrated. The i th heart period was derived as the time interval between the i th and $(i+1)$ th R-wave peaks detected on the ECG. The respiratory flow signal was sampled once per cardiac beat at the occurrence of the i th R-wave peak.

When using this resource please cite the following references

- [1] A. Porta, S. Guzzetti, N. Montano, M. Pagani, V. Somers, A. Malliani, G. Baselli, S. Cerutti, Information domain analysis of cardiovascular variability signals: evaluation of regularity, synchronisation and co-ordination, *Medical & Biological Engineering & Computing*, 38, 180-188, 2000.
- [2] A. Porta, T. Bassani, V. Bari, G.D. Pinna, R. Maestri, S. Guzzetti, Accounting for respiration is necessary to reliably infer Granger causality from cardiovascular variability series, *IEEE Transactions on Biomedical Engineering*, 59, 832-841, 2012.

Description of the dataset and file format

The zip file contains the beat-to-beat variability series of heart period and respiratory flow. File naming follows the format Y24zzxxx.dat with

Y = T: beat-to-beat series of heart period

Y = R: beat-to-beat series of respiratory flow

zz = identification number of the subject (from 1 to 20, 11 is missing)

xxx = r: spontaneous breathing

xxx = c10: paced breathing at 10 breaths/minute

xxx = c15: paced breathing at 15 breaths/minute

xxx = c20: paced breathing at 20 breaths/minute

The files are streams of items in binary format. Each item is formed by three float*32. The first float is a progressive counter reporting the position of the i th R-wave within the original ECG file expressed in number of samples, the second float is the value of the series with the heart period expressed in seconds and the respiratory flow expressed in arbitrary units, and the third float is a label indicating the quality of the measurement (0 = good quality).