Physiological time series processed with local trigonometric transform and scaling analysis

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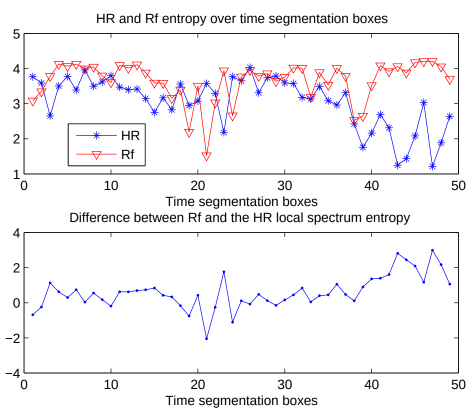
The aim of this study was to detect changes and measure randomness of physiological time series recorded in exhaustive exercises like high mountain ascents or marathon races[1]. There is an ever increasing number of people who climb at an altitude of 5,000 m during trekking trips proposed by commercial tour operators. These high-altitude ascents represent a major challenge for the majority of these subjects, as many are not acclimatized or accustomed to walking on icy and steep paths. In Europe, one of the most popular summits is Mont Blanc (4,808 m), with approximately 20,000 climbers each year. On the other hand, in the last 20 years, marathon running became a social and athletic phenomenon with 60,000 runners taking part in the races each year. There are around 35,000 participants in Paris, New York or London. The marathon race is no longer reserved to elite runners, and the average performance is 3 h 50 min. The incidence of sudden death (cardiac arrest) happening during or following long exhaustive exercise as marathon, increases.

This work uses local trigonometric[2] orthonormal basis to extract local spectrum over segmented time boxes and the detrended fluctuation (DFA)[3] or the wavelet leaders (WL)[4] analysis to extract scaling law exponents. We will show heart rate and respiratory time series recorded simultaneously during a high altitude mountain ascent and heart rate, speed and heart cost marathon time series. Their local spectrum, power law exponents, Shannon entropy and low vs. high energy over time segmentation boxes were used to detect changes and measure randomness with altitude or fatigue. The difference between the respiratory frequency (Rf) and the heart rate (HR) local spectrum entropy over segmentation boxes increases with altitude (Figure)



Références

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