

# **Analysis of Heart Rate Variability during Meditation by a Pattern Recognition Method**

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The main objective of this study is to investigate patterns of heart rate variability during concentration meditation to understand its effects on health, especially, on Autonomic Nervous System. Our method consisted of three major stages beginning with a stage of signal acquisition, which was a collection of RR interval time series signals during meditation and ordinary quiet sitting. Then, the RR interval signals were passed through a stage of feature extraction, yielding features in terms of heart rate variability measures from both time domain and frequency domain analysis methods. The final stage was a classification, which the K-mean algorithm had been applied to classify the RR interval time series signal into the appropriate groups. The signals were collected from 105 subjects. There were totally 2,331 segments of the signals. Experimental results revealed that the effective features for the signal classification were mean heart rate, autocorrelation, normalized power spectra in very low frequency (VLF), low frequency (LF), and high frequency (HF) ranges, width of the highest spectral peak, and frequency of the highest spectral peak. By K-mean clustering method, the signals could be classified into 3 clusters corresponding to Samadhi state, intermediate state, and normal state. The clustering result was consistent with subjects self-report. Characteristics of heart rate variability can be summarized as follows. During Samadhi state, the RR signal becomes more regular, and the spectrum shifts towards a specific frequency to form one single prominent peak, while in the normal state the RR signal is irregular, and there are many spectral peaks spreading throughout the VLF and LF ranges. The results indicate that meditation and ordinary quiet sitting have significantly different effects on health. In addition, it should be noted that meditation may give different effects on health depending on frequency of resonant peak that each meditator can achieve.