Clustering Analysis on Heart Rate Variation in Daytime Work

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ABSTRACT

Modern society tends to bring excessive labor to people and, therefore, further health management is required. In this paper, by using the clustering technique, one of machine learning methods, we try to bring out the measure of fatigue from heart rate (HR) variation during daytime work, helping people to get high-quality of healthy and calm life.

Keywords : heart rate variation, clustering analysis, machine learning, degree of fatigue in a day, healthy life.

1. Introduction

According to the "National Life Basic Survey" conducted by the Ministry of Health, Labor, and Welfare of Japan, 52.5 million people, about 48% of Japanese over aged of 12, are suffering from stress in their daily lives. And also, according to the Korea Institute of Health and Social Research, a questionnaire survey (2016) on stress, 7 thousand of adults turned out that more than 90% of the total felt stress. As these figures shown, modern society tends to bring excessive labor to people and, therefore, further health management is required.

Then, in this paper, by using the clustering technique, one of machine learning methods, we try to bring out the measure of fatigue from heart rate (HR) variation during daytime work, helping people to get high-quality of healthy and calm life.

2. Sample of HR variation and Clustering analysis

Fig.1 shows the time series of heart rate and its Poincare plot of healthy female, aged 40s, in the morning work from 10:15 to 12:25, measuring interval of 7,762 seconds and depicts the three-cluster Poincare plot of HR variation; the average, maximum, minimum, standard value of HR are 68.8 [bps], 167.0 [bps], 37.0 [bps], and 15.7 [bps], respectively. Applying the clustering method with three clusters on the HR variation shows that for low, moderate, and high cluster, mean value of HR, number of included points, and the percentile to whole time interval of 7,762 seconds are shown in Table 1 (a). In the morning work, she dedicated herself mainly to desk-work in the calm office on the second floor (noted green line) from 11:40, except standing-work during 11:40 to 11:55.
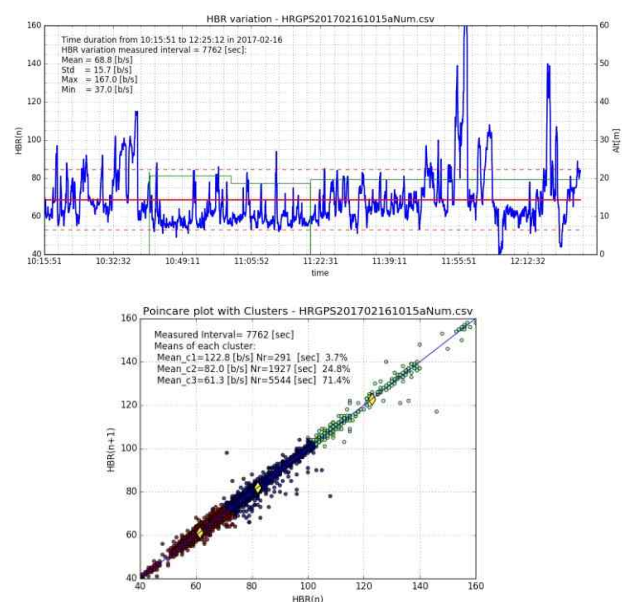

Fig.1 Time series of heart rate and its Poincare plot in the morning work from 10:16 to 12:25.
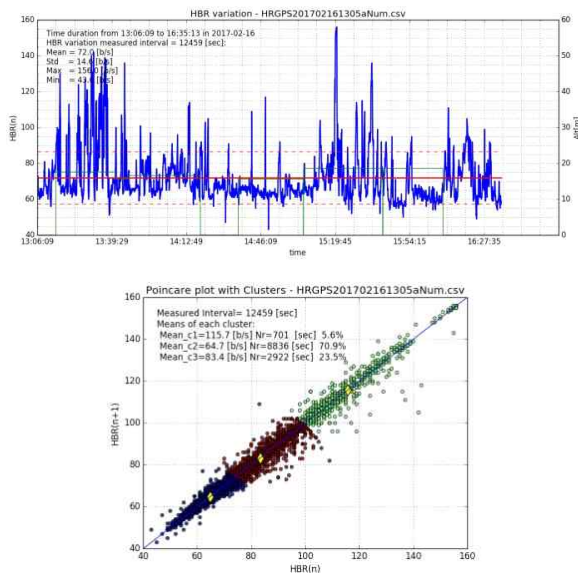
Fig.2 Time series of heart rate and its Poincare plot in the afternoon work from 13:06 to 16:35.

Fig.2 shows the heart rate variation in the afternoon work from 13:06 to 16:35, working almost at standing position on the second floor; the average, maximum, minimum, standard value of HR are 72.0 [bps], 156.0 [bps], 43.0 [bps], and 14.6 [bps], respectively. Applying the clustering method with three clusters on the HR variation shows that for low, moderate, and high cluster, mean value of HR, number of included points, and the percentage to whole time interval of 12,459 seconds are also shown in Table 1.
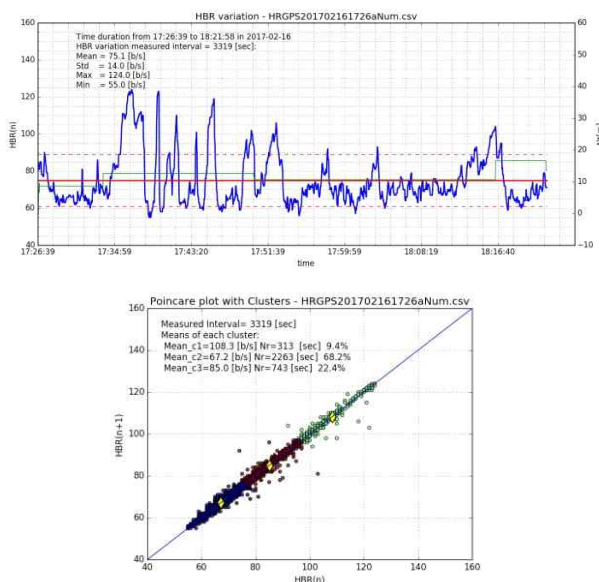

Fig.3 Time series of heart rate and its Poincare plot in the evening work from 17:26 to 18:21.

Fig.3 shows the heart rate variation during the evening meeting from 17:26 to 18:22, discussing about the agenda of the day feeling some tension; the average, maximum, minimum, standard value of HR are 75.1 [bps], 124.0 [bps], 55.0 [bps], and 14.0 [bps], respectively. Applying the clustering method with three clusters on the HR variation shows that for low, moderate, and high cluster, mean value of HR, number of included points, and the percentage to whole time interval of 3,319 seconds are also shown in Table 1.

Table 1. Degree of fatigue

Daytime work		Level of fatigue	Average HR [bps]	Low cluster		Moderate cluster		High cluster	
				Average HR [bps]	Percentile [%]	Average HR [bps]	Percentile [%]	Average HR [bps]	Percentile [%]
Morning	Desk work	low	68.8	61.3	71.4	82.0	24.8	122.8	3.7
Afternoon	Standing work	medium	72.0	64.7	70.9	83.4	23.5	115.7	5.6
Evening	In a meeting	high	75.1	67.2	68.2	85.0	22.4	108.3	9.4

3. Conclusion

As shown in Fig.1 and Table 1, the average heart rate increases in the evening, the percentile of time zone occupied by the low cluster becomes short, whilst the percentile of time zone occupied by the high clusters tends to be long. We think it is necessary for the cooperate lady to have a good night's sleep for tomorrow's activities.

4. Acknowledgements

■ References ■

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