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医療・福祉・介護

A Novel Interpolation Method for One Dimensional Bio-signals

TECHNOLOGY SHOWCASE

■ Introduction

With the development of electronic information technology in recent years, the applications of bio-signals in health care and clinic have become popular[1]. In particular, with the rapid growth of wearables and wireless devices in the Internet of Things (IoT) field, bio-signals such as pulsebeat and SpO2 can be analyzed easily and cheaply for users without a medical background. However, although handy, this kind of inexpensive quasi-medical device is extremely susceptible to interference from the surrounding environment to the point of outliers and missing values. Both the missing values and outlier can be considered as a fake alarm leading to incorrect choice by the device user. Reducing the probability of fake alarms is critical for medical devices. Therefore, this study proposes a new algorithm to eliminate the negative effects of missing values and outliers on the digitized bio-signals[2].

■ Activities

1. Target bio-signal

In this study, an electrocardiogram (ECG) signal was chosen as a target. ECG was the first to be widely used in the clinical field and the most successful to be wearable and miniaturized among all bio-signals. It is because ECG is so easily available that we chose it as our target. The difference is that the ECG used in this case was obtained from a chest-induced and with 1000 Hz sampling rate

2. Outline of the proposed method

The primary purpose of this manuscript is to fill in the missing values in the signal by the interpolation method. The approximate process of this algorithm is: a bio-signal is decomposed into three sub-signals: trend sub-signal, periodic sub-signal, and random sub-signal. The machine-learning based interpolation method fills in the missing values on each of the three sub-signals. Finally, a perfect signal is obtained by reconstructing the sub-signals, as shown in Fig.

■ Experiment

1. ECG signal acquisition and processing

In this study, a 3-minute s ECG signal was measured from a young participant and was cut into random lengths. Select ten sets of data for the experiment and require each data set to contain at least one full waveform and at most ten full waveforms (the remaining sets were used for machine learning). Artificially created outliers and missing values were added to the ten sets of data.

2. Processed by standard methods and the proposed method

The proposed methods mentioned earlier, plus two standard methods, a total of three interpolation methods were used to process the signals. The two standard methods are polynomial-based linear interpolation and Kriging-based nonlinear interpolation, respectively[3].

3. Comparisons and statistics

The signal processed by the three interpolation methods is compared with the original signal. The comparison method preferred RMSE and R2 scores in this study, and the results of 10 data sets of the three methods were statistically counted.

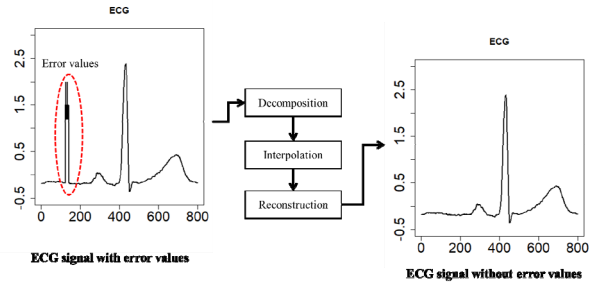

Fig. Before and after ECG signal interpolation

4. Results

The results of this study will be presented by poster at the conference.

■ References

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■キーワード: (1) Linear Interpolation
(2) Nonlinear Interpolation
(3) Machine Learning Interpolation Method

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