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Easy Extraction of Blood Pressure Variability from Body Video Images Using Simulink*

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***Abstract*—A system using Simulink (MathWorks, Inc.) has been developed to obtain the instantaneous phase difference (PD) between two photoplethysmograms measured with two video signals taken at a face and a hand, which is associated with the pulse transit time. The experimental results obtained from 20 healthy subjects in drastic change in blood pressure caused by one minute-long apnea have suggested that the PD correlates *positively* with blood pressure variability.**

I. Introduction

It has been reported that the photoplethysmogram (PPG) can be extracted from the green component of a video signal (G-signal) of a human body taken with a video camera, which is an affordable, remote and non-contact measurement method to obtain heart rate [1]. It is, of course, difficult to measure the absolute value of blood pressure in the similar way to the above method based on the video signal.

It has also been well known that the pulse transit time (PTT) correlates inversely with blood pressure. This fact can be applied to monitoring of blood pressure variability for the prevention of death caused by a heat shock in a bath.

In the present study, a system using Simulink (MathWorks, Inc.) has been developed to obtain the instantaneous phase difference (PD) between two PPGs measured with two video signals, which is associated with the PTT. In the experiment using 20 healthy subjects, it has been ascertained whether the PD correlates with blood pressure variability.

II. Methods

The developed system consists of three parts as follows:

A) Pre-processing part (Initial callback function)

B) On-line part (Main body of Simulink)

C) Post-processing part (Stop callback function)

In the part A), two rough regions of interest (ROIs) including proximal and distal body parts (e.g., a face and a hand, respectively) are assigned in a video image.

The part B) extracts two PPGs in an on-line fashion from the video image taken with a video camera connected with a personal computer. The part B) consists of the followings:

a) Separation of skin color region based on HSV-conversion from RGB signal

b) Automatic intensity limiter based on brightness distribution in the separated skin color region

c) Extraction of the PPG obtained as a time series of mean intensity from the G-signal including a median filter, a subsubsystem for cancelling the effect of an automatic gain control, and a band-pass filter in each ROI

d) Display output of the video image modulated by the intensity signal resulting from the PPGs

In the part C), the PD is calculated as the difference between instantaneous phases of analytic signals obtained from the Hilbert transform of the PPGs.

In the experiment, 20 healthy subjects participated and drastic change in blood pressure was induced by one minute-long apnea within a 5 min-long trial at rest. The PD was calculated from the video signal at a face and a hand.

III. Results and Discussion

Figure 1 shows an example of the display output of the video image superimposed by the intensity signals of the PPGs.

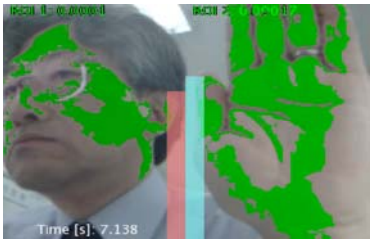

Fig. 1 Example of display output.

The experimental result showed that the PD correlated positively with blood pressure variability with a correlation coefficient r=0.65. The positive correlation may be caused by the increase in delay in surface blood perfusion at the hand with the increase in blood pressure.

IV. Conclusions

The cause of the positive correlation should be ascertained further in terms of localization of autonomic nervous control.

Reference

[1] M. Yoshizawa, *et al*., "A great impact of green video signals on tele-healthcare in daily life, especially for rural or disaster areas," 35th Annu. Inter. Conf. of IEEE EMBS, http://embc.embs.org/files/2013/1638_FI.pdf (2013)

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