

着衣可能な容量型呼吸センサ

Wearable Capacitive Breathing Sensor

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【Introduction】 Monitoring the breathing during the exercising is important, since this shows the actual lung function. Conventional measurements use the sensors with the masks and the thermal sensitive resistors. These sensors are fixed on the body being connected with cables or pipes. Since the subjects are stressed, the breathing tends to be far from the natural one. In this study, a wearable capacitive sensor is tried for measuring the breathing for not to disturb the subject's exercising.

【 Principle 】 Figure 1 shows the possible principle of the capacitance change caused by the breathing. The material of the body is mainly water, whose permittivity is about 80 and the conductive electrolytic solution. The air which flows into or out of the lung has the value of about 1 and non-conductive material. When the subject breathes, the regions of body material and air will change inside. When the electrodes are fixed facing each other across the body, the capacitance value should reflect the change inside the body.

【Sensor】 A hand-made circuit consists of power supply and C/V converter in a box (90x60x50 mm³) connected by the cable (φ7mm, 4 lines). C/V converter is connected to the electrodes on the shirt. Figure 2 shows the T-shirt. The electrodes (conductive textile fixed inside T-shirt) are placed at the front and the backside. Its surface is covered by the film for the water protection. The electrode can slide on the skin keeping the comfortable condition.

【Results】 Figure 3 shows measured capacitance signals. Two C/V converters are included in one box. Signals are measured at the abdomen and the chest. They will correspond the abdominal and the costal breathing. The electrode sizes are both 50x50mm². Both signals show the breathing cycle clearly. The increasing or decreasing of the signal is opposite between two signals. The reason is not clear at present but this indicates the sensor measures the change inside the body.

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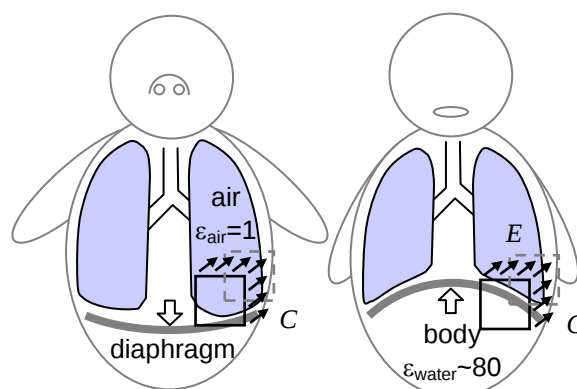


Fig. 1: Possible principle for measuring the breathing showing the change inside the body.

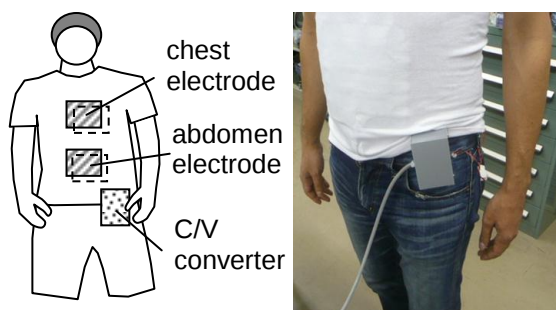


Fig. 2: Wearable sensor system using hand-made C/V circuit and the electrode fixed on the shirt.

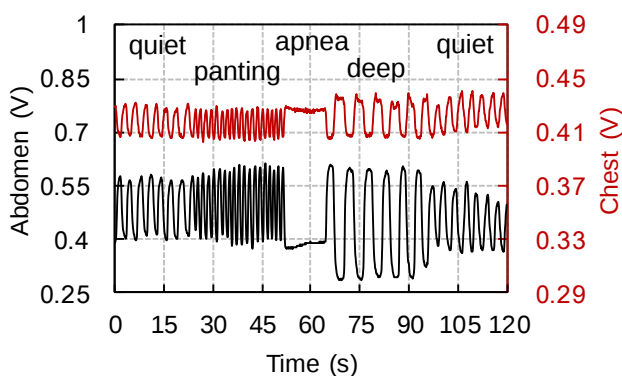


Fig. 3: Obtained two sensor signals from capacitances at the abdomen and the chest. The frequency is different each other. Sampling rate is 10Hz.