

Gait detection based on thigh pitch angle

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Abstract

Gait detection obtains gait information by analyzing the data characteristics obtained. It is widely used in navigation, positioning, sports training and other scenarios. This paper presents a method to discriminate gait based on the leg pitch angle. The algorithm discriminates gait by using the threshold of the leg pitch angle. The data show that the accuracy of gait recognition by thigh elevation angle is as high as 99%. It has good application prospects.

Keywords

Gait detection; Inertial technology; attitude.

1. Introduction

Gait detection derives gait information by analyzing the data characteristics obtained, and has been widely used in many fields^[1]. The accuracy of gait detection is critical for application, but the portability and economy of the device need to be considered^[2].

The traditional gait analysis method using photoelectric system is expensive and unfavorable for application. As technology advances, wearable sensors have the advantage of being inexpensive and convenient^[3-5]. The inertial sensor can get the angular velocity and acceleration information of the carrier, through which the attitude angle information can be further calculated. Attitude information of each position can be obtained by equipping the inertial sensor in all parts of the human body. This paper presents a gait detection method based on thigh pitch angle. The sensor is bound to the leg to get its posture information, and then the gait change can be identified by setting a threshold.

2. Programme

The angular velocity and acceleration information of the left and right thighs can be obtained by placing the inertial measurement units integrated with the three-axis accelerometer and the three-axis gyroscope on the left and right thigh bones respectively, and then the angular information of the left and right thighs can be obtained by posture calculation. The quaternion method is used to solve the posture. The principle is to solve the Quaternion Differential equation, as shown below:

$$\dot{Q} = \frac{1}{2} Q \otimes \omega_{nb}^b \quad (1)$$

Gait is judged by setting a threshold after obtaining the posture angle information of the left and right thighs.

3. Experimental verification

The experimental scene is a straight road with an inertial measurement unit worn on the left and right thighs and receiving data from the sensor through the upper computer. The results of restoring the pitch angle waveform of gait in MATLAB are as follows :

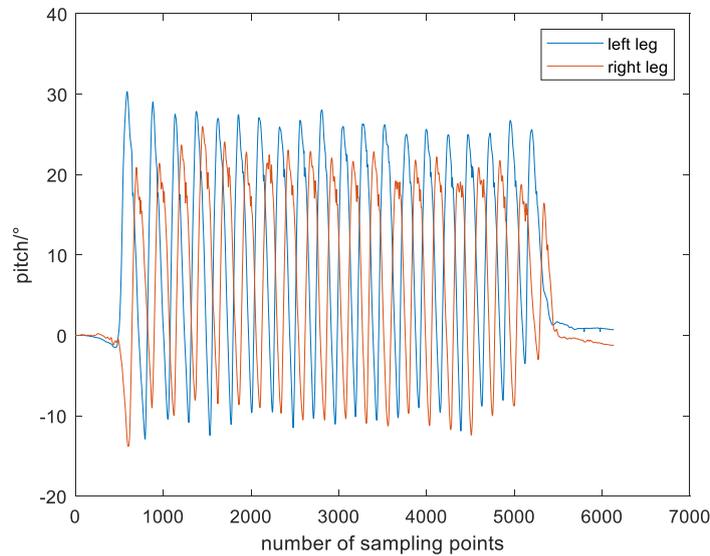


Fig.1 Thigh pitch waveform

As you can see from Fig. 1, step information can be obtained by setting a threshold to get the peak leg pitch angle, and the result is as follows :

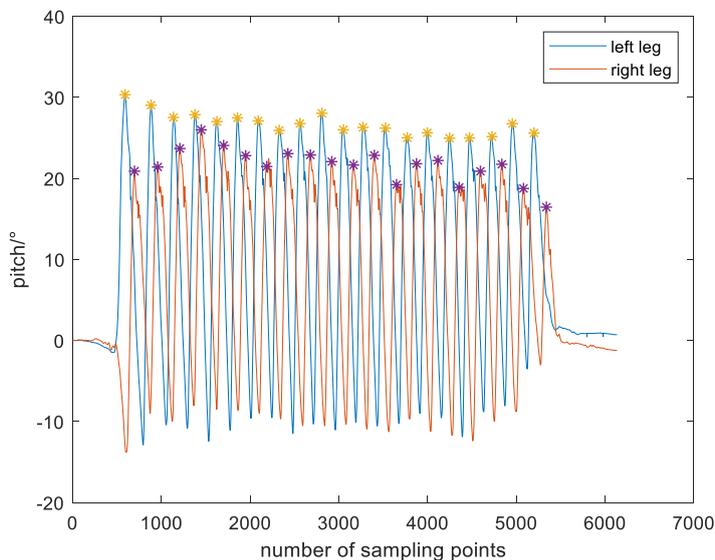


Fig.2 Gait detection results

Repeat multiple groups of experiments as shown in the table below :

Tab.1 Experimental result table

Test Group Number	Actual steps	Detection steps	Accuracy rate (%)
1	40	40	100
2	41	40	97.56
3	39	38	100
4	40	40	100
5	41	41	100
mean value	-	-	99.51

As can be seen from the table, the average accuracy of gait detection in this scheme is 99.51%.

4. Conclusion

This paper presents a gait detection algorithm based on pitch angle. The sensor is bound to the leg to get its posture information, and then the gait change can be identified by setting a threshold value. The result shows that the average accuracy of gait detection of this scheme is 99.51%, which has a wide application scenario.

References

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