Vertical Jump Flight Time Measurement: A New Method Based on Acceleration Signals

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In this paper we present a new method for measuring the vertical jump flight time using signals from an acceleration sensor. The accelerometer signal characteristic vertical jump curve is presented; six interest zones corresponding to key stages in the kinetic activity are identified and described as: rest, preparation, take-off, flight, landing, and recovery.

The apparatus consisted of a bioPlux8 wireless electrophysiological data acquisition unit with a xyzPlux triaxial accelerometer to measure the vertical jump acceleration signals along two dimensions. For result comparison purposes, a force platform signal was synchronously measured in the unit. The methodology to compute the time of flight was based on the morphological study of a set of jumps.

Notable points from the acceleration signal were identified, which relate to the take-off and landing events. Three methods were devised, each using different time and amplitude measurements, extracted from the accelerometer characteristic wave. The first method uses the landing stage curve amplitude; the second method uses the distance between minimum acceleration value during the flight period and the minimum acceleration value on the landing stage; the third method uses the minimum amplitude value during the flight period from the curve determined by a low pass filtering of the acceleration signal (which is equivalent to an integral computation).

To validate these methods, a standard algorithm to compute the flight time from the force platform signals was employed and these values taken as ground truth. The proposed approaches were evaluated against the results obtained from the force platform and the different methods compared. Performance assessment was performed by computing a proportional constant between the values obtained with each of the proposed approaches and the values from the force platform.

The non linearity error for flight time measurements between the accelerometer and the force platform was also computed. Preliminary results for a set of 21 jumps led to errors of: 4.3% (16.5 ms), for the first method; 3.30% (12.6 ms), for the second method; and 2.67% (10 ms), for the third method. On the platform itself it was detected a non linearity error of 0.5% associated with the use of different algorithms to compute the flight time.

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