

## The analysis of consecutive cycles in sports performance. A new perspective in sports biomechanics research

Oriol Abellán Aynés<sup>1</sup>

<sup>1</sup> Facultad de Deporte, UCAM Universidad Católica San Antonio de Murcia, Murcia, España

In daily activities, the vast majority of natural events, the actions we perform or the events that occur around us are cyclical in nature. Many of these events occur consecutively, are repeated with greater or lesser frequency and, consequently, have shorter or longer periods. These cyclical events are determined by a process in which the final and initial states coincide and are repeated successively in a defined or indefinite temporal space.

As for the cyclic events present in the human being and which have been the subject of study in the field of physical exercise, we can find in the physiology field some well-known ones such as breathing, heartbeat or hormone regulation. In the field of sports performance at a physiological level, we are used to terms such as heart rate or respiratory rate, in both cases we are referring to the number of times that the beginning of a cycle that is repeated consecutively occurs. If we examine in depth what we are quantifying in this type of variable, we might realize that we are interpreting consecutive cycles with the use of mean values, that is, we use the mean to give a value to an indefinite number of cycles that could be different from each other. Should we consider whether quantifying a succession of so many cycles with the mean value is correct to represent the behavior of this type of events?

In the 1960s, a concept emerged that is now very popular in the world of sports performance, among others, heart rate variability. Those who are familiar with this concept will know that consecutive heartbeats do not exhibit equal periods, but that each heartbeat has a different duration than the others. Furthermore, we know that the more these heartbeats differ from each other in a given time interval, the better the condition of the athlete generally is, the better the health or the better the recovery after a training stimulus. So, if we know that each cycle is different from the rest, why do we still quantify with average values and not analyze the relationship of variability between consecutive cycles in events that are repeated successively?

The heartbeat is not the only one in which this lack of regularity and balance has been observed, but many other biological systems show this lack of stability in their consecutive cycles, indicating a better performance of them. If we leave the analysis of biological systems, it has also been observed that some kinematic factors such as gait show balance in their cycles as a factor of aging or impaired health. Therefore, in biomechanical aspects we could think that those events that are repeated consecutively in the form of cycles may be interesting to cease to quantify with mean values and begin to quantify the relationship between consecutive periods.

In the last year the first pilot studies have begun to emerge in sports with a very marked cyclical character such as canoeing or swimming. For the moment, there are no conclusive data, since this is a research line that is just beginning to emerge. However, the first results

show something very different from what happened with biological cycles: sports performance seems to be marked by greater stability between cycles, i.e., less variability. In these sports we have mentioned, it seems logical to think that the more constant the stroke is, the more efficient the maintenance of a higher speed will be, avoiding a longer duration of negative accelerations caused by the environment on which it travels. Therefore, the questions that arise are: will the analysis of cyclic events finally be determinant in the performance of these sports? will the same happen in other cyclic sports in other environments such as running or cycling? in which other cyclic sports does it make sense to analyze the presence or absence of stability between cycles?

We could say that there is a wide research direction that opens its doors and that could be determinant in the understanding of which factors can be influencing in the sports performance of those naturally cyclic sports.