

## **An analysis of high performance in long-distance rowing by means of global positioning system technology**

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### **Abstract**

The analysis of high sports performance by means of technological advances has often been used to calculate the routes of sportsmen in the distances covered, or to calculate speed in orienteering. However, there is still little information on data for GPS use in long-distance elite rowers. The purpose of this study was to analyze rowers' performance in a long distance fixed-seat rowing competition (Santa Pola, March 2007, Spain). The official distance for this event is 14816 meters and, in that competition the temperature was  $28,8 \pm 2,23$ .

Five boats, with eight rowers each, were used for this analysis, all with GPS technology. The calculations included the total time for the race, distance covered by each boat, speeds, route profile, altimeter, temperature and heart rate. The GPS model used on the rowers occupying the first post in each boat was FRWD outdoor sports computer series W 600 (2007). Each GPS was calibrated before the start of the event in order to collect data, together with a recording unit and a computer containing the software required. After the event, the statistical analysis was performed by means of the SPSS 13.0 package in order to compare the data for the various times obtained, speed, route profile and heart rate.

The first significant result of the comparison showed that the average speed of the boats in the event was  $9,95 \pm 1,35$  km/h. A second result described the time:  $91,53 \pm 14,13$  minutes. Finally, the third result analyzed was the heart rate:  $170 \pm 4,69$ .

An improved knowledge of these variables is very important in order to set specific training patterns for long-distance rowing, which may lead to further research on rowers' physiological response when faced with competitive effort. The results suggest that this study could widen the knowledge of competition in this sport.

### **Introduction**

Global positioning system (GPS) technology has often been used in the literature on orienteering (Larsson et al., 2002). This was a turning point in the study of this sport, since one of the main performance factors leading to success is, finding the most suitable route between the control points, and GPS is the tool that makes it possible to store and offer this information.

Competition in rowing events present significant differences compared to orienteering races. The main difference lies in the fact that, in rowing, the position of the control points is known beforehand, although in long-distance races they cannot be seen at first sight (Battista et al., 2006). There are different event formats, mainly differing in the distance to be covered (long or short distance), and the movement of the rower, whether on a fixed or a sliding seat.

This study attempts to provide new information on long-distance fixed seat rowing events, based on the usage of GPS technology. There is little information collected in competition situations on the variables determining performance in this category. By obtaining this information, the training programmes can be optimized and greater success in competition can be achieved.

## Methodology

Five boats, with eight rowers each, were used for this analysis. The event was the long-distance regional championship in the Valencian Community, in the "Falucho" category (Santa Pola, March 2007, Spain). All rowers were amateur, since there are no professional rowers in this category. The coxswain in each boat wore (in his arm) a GPS recording unit (outdoor sports computer series W 600), and each rower wore a Polar S625X pulsometer, which registered his heart rate.

The software used in order to analyze the data was FRWD outdoor sports computer series for the GPS data, and Polar Precision Performance 5.0 for the analysis of the heart rate data.



Figure 1. GPS FRWD W 600



Figure 2. Polar S625X Pulsometre

The calculations included the total time for the race, distance covered by each boat, speeds, route profile, altimeter, temperature and heart rate. Each GPS was calibrated before the start of the event in order to collect data, together with a recording unit and a computer containing the software required. After the event, the statistical analysis was performed by means of the SPSS 13.0 package, in order to compare the data for the various times obtained, speed, route profile and heart rate.



Figure 3. Boats and rowers in competition



## Results and Discussion

The official distance for this event is 14816 meters, and in that edition the average temperature outdoor was  $28,8 \pm 2,23$  degrees centigrades.

The first significant result of the comparison showed that the average speed of the boats in the event was  $9,95 \pm 1,35$  km/h. There is a statistically significant difference between the first two boats analyzed (ranking 2nd and 3rd in the event) and the other three which reached intermediate positions in the final standings. There were no significant differences in the maximum speeds; there were, of course, in the final timing, where there is a clear difference between the first two boats and the others.

It is important to note the different distance covered by the various boats because, although the official distance was the same for all entrants, the second and the third boat chose optimal routes, which allowed them to cover a shorter distance than the other boats, ranking 8th, 9th and 14th. This result, added to their higher average speed, resulted in a better time in the race. The coxswain's skill and experience shows itself as a performance factor in this type of event.

**Table 1. Data obtained in competition**

Boat Names	Ranking	Total Time (minutes)	Distance Covered (metres)	Average Speed (kilometres per hour)	Maximum Speed (kilometres per hour)	Average Heartbeat Rate (per minute)	Maximum Heart Rate (per minute)	Total Heartbeat Number	Average Temperature (degrees centigrades)	Maximum Temperature (degrees centigrades)
Real Club de Regatas	2 <sup>o</sup>	76.05	14460	11.45	13.4	171	193	13922	28.6	31.2
Universidad Politécnica de Valencia	3 <sup>o</sup>	76.15	14480	11.4	13.3	173	191	13990	28.8	31.4
Universidad de Alicante	8 <sup>o</sup>	100.38	15086	9.1	13.6	175	192	14175	29.1	31.1
Oliva Regatas	9 <sup>o</sup>	101.53	15315	9.1	13.3	168	188	14574	25.6	27.1
Denia Remeros	14 <sup>o</sup>	103.54	14874	8.7	12.1	163	183	15159	31.9	35.7
<b>Average Datas</b>		<b>91.53+-14.13</b>		<b>9.95+-1.35</b>		<b>170+-4.69</b>			<b>28.8+-2.23</b>	

The comparison between these data and the heart rate does not yield any significant statistic correlation. The heart rate depends on intrinsic individual parameters (age, training level, rest...) and on extrinsic ones (temperature, humidity...) (Russell et al., 1998). These heart rate data are determining factors in quantifying how intense the event has been, and the individual effort it has entailed for each rower.

By obtaining these data and determining the anaerobic and aerobic thresholds, by means of an effort test on an ergometer, the intensity of competition may be determined, and therefore, optimized training programmes can be scheduled in order to obtain better results in events.

## Conclusion

The GPS is a suitable tool for recording data in long-distance rowing events. The data obtained make it possible to analyze and describe intrinsic and extrinsic data on the rowers and the whole boat.

Such data, together with the individual heart rate recorded, yield actual information on how intense the competition has been for each rower and for all the boats.

By means of the heart rate, and by determining the anaerobic and aerobic threshold for each rower, the effort entailed by an event can be determined, and therefore, performance can be optimized through individualized training programmes.

Using the route profile obtained during the event, the coxswains' training can be optimized in different situations, in order to obtain better results in future events.

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