

Measuring energy expenditure in sports by thermal video analysis

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1 Experiments

Traditionally, in sports science, energy expenditure is measured directly by oxygen uptake [1]. Therefore, the developed video based method is evaluated against oxygen uptake. The experiment is divided into two tests with different running protocols. As shown in Figure 1 and 2, a test person need to run along the red track, including the red line and the red circle. The blue thing is a thermal camera, and two rays are the range of radiation. A tester need to run 5km/h (walking), 8, 10, 12km/h (running) in each running protocols.

1.1 Results

Each ratio graph local maximum can be interpreted as a step or cyclic repetition of motion. Table 1 summaries the number of detected maximums and the gross oxygen uptake measured at the same sequence. Figure 3 and 4 plot these results.

2 Discussion

Results are observed that the two difference test scenarios have different energy costs. As the increase of running ratio, the difference in gross oxygen uptake is getting bigger between line and circle patterns, and line pattern requires more energy than the circle pattern. The results indicate

a linear correlation between the new non-invasive measurement method and oxygen uptake [2].

Reference

- [1] A.V.Hill and H.Lupton. The oxygen consumption during running. *The Journal of Physiology*, 56:xxxii–xxxiii, 1922. 1
- [2] Rikke Gade, Ryan Godsk Larsen, and Thomas B. Moeslund. Measuring energy expenditure in sports by thermal video analysis. In *The IEEE Conference on Computer Vision and Pattern Recognition (CVPR) Workshops*, July 2017. 1

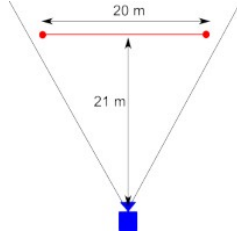


Figure 1: Sketch of test setup for test 1.
Participant runs along the red line and turns at each end point.

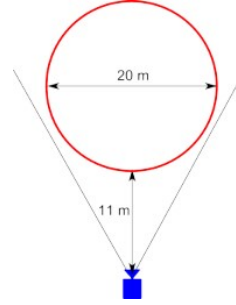


Figure 2: Sketch of test setup for test 2.
Participant run along the red circle.

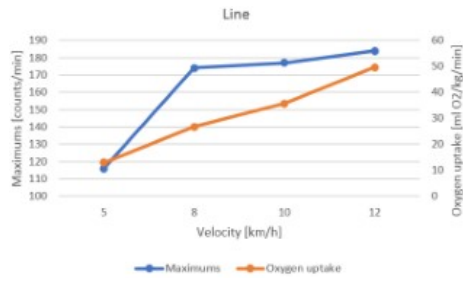


Figure 3: Results of test 1.

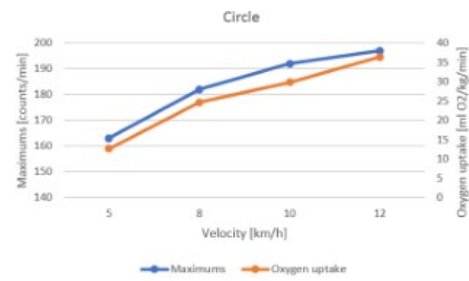


Figure 4: Results of test 2.

Table 1: Oxygen uptake and step counts from both tests.

		5km/h	8km/h	10km/h	12km/h
Line	Gross oxygen uptake [ml O ₂ /kg/min]	13.0	26.8	35.7	49.6
	Maximums [counts/min]	116	174	177	184
Circle	Gross oxygen uptake [ml O ₂ /kg/min]	12.7	24.7	29.8	36.4
	Maximums [counts/min]	163	182	192	197