Physics > Popular Physics

Optimal Pacing for Running 400 m and 800 m Track Races

James C. Reardon

(Submitted on 2 Apr 2012)

Physicists seeking to understand complex biological systems often find it rewarding to create simple "toy models" that reproduce system behavior. Here a toy model is used to understand a puzzling phenomenon from the sport of track and field. Races are almost always won, and records set, in 400 m and 800 m running events by people who run the first half of the race faster than the second half, which is not true of shorter races, nor of longer. There is general agreement that performance in the 400 m and 800 m is limited somehow by the amount of anaerobic metabolism that can be tolerated in the working muscles in the legs. A toy model of anaerobic metabolism is presented, from which an optimal pacing strategy is analytically calculated via the Euler-Lagrange equation. This optimal strategy is then modified to account for the fact that the runner starts the race from rest; this modification is shown to result in the best possible outcome by use of an elementary variational technique that supplements what is found in undergraduate textbooks. The toy model reproduces the pacing strategies of elite 400 m and 800 m runners better than existing models do. The toy model also gives some insight into training strategies that improve performance.

Comments:	14 pages, 4 figures, submitted to the American Journal of Physics
Subjects:	**Popular Physics (physics.pop-ph)**; Biological Physics (physics.bio-ph); Physics Education (physics.ed-ph)
Cite as:	**arXiv:1204.0313 [physics.pop-ph]**
	(or **arXiv:1204.0313v1 [physics.pop-ph]** for this version)

Submission history

From: James Reardon [view email]
[v1] Mon, 2 Apr 2012 05:12:23 GMT (116kb)

Which authors of this paper are endorsers?