Behncke, Horst

A mathematical method for the force and energetics in competitive running. (English)

Zbl 0782.92007
J. Math. Biol. 31, No. 8, 853-878 (1993).

The aim of this paper is to study a relatively simple optimization model for the force, energetics and velocity profile in running. The model, an extension of the previous formulation by the author in Math. Methods Appl. Sci. 9, 298-311 (1987; Zbl 0626.49009), is made up of three submodels, which take account of the biomechanics, the energetics and the optimization.

From the biomechanical point of view, a more general and realistic expression for the resistance is used. The model for the energetics, an extension of the hydraulic model of *R. Margaria* [Biomechanics and energetics of muscular exercise. Oxford (1976)] and *R. H. Morton* [J. Math. Biol. 28, No. 1, 49-64 (1990; Zbl 0717.92012)], uses three vessels for the three sources of muscular energy (phosphagen, glycolysis and oxidation of glucose and lipids), includes a maximum glycolytic rate and takes into account the finiteness of the third vessel, and allows to consider both long and short distance runs. The key parameters of this piecewise linear, three-compartment model are determined on the basis of physiological data and the model yields a reasonable good fit to the data from world records.

Reviewer: D.Jou (Ballaterra)

MSC:

92C45 Kinetics in biochemical problems (pharmacokinetics, enzyme kinetics, etc.)
92C10 Biomechanics
49N70 Differential games and control
49N75 Pursuit and evasion games
49J15 Existence theories for optimal control problems involving ordinary differential equations

Keywords:

phosphagen; optimization model; force; energetics; velocity profile; running; submodels; resistance; glycolysis; oxidation of glucose and lipids; maximum glycolytic rate; piecewise linear, three-compartment model

Full Text: DOI

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