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SOLVING A BACKPACK VIBRATION SYSTEM USING FOURTH-ORDER RUNGE-KUTTA METHODS

(Penyelesaian Sistem Regangan Beg Galas Menggunakan Kaedah Runge-Kutta Peringkat Keempat)

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ABSTRACT

A backpack vibration system involving ordinary differential equations has been developed in this study. The purpose of this research is to solve a biomechanical model of a backpack vibration system numerically. The model is a backpack-human trunk system, represented by a mass-spring system that uses a Fourier series as an external force to describe a motion of the backpack. The displacement and velocity of the backpack vibration system are determined using two numerical methods; the classical fourth-order Runge-Kutta method (RK4) and a modified fourth-order Runge-Kutta method, namely Arithmetic Mean fourth-order Runge-Kutta methods (AM-RK4). The numerical results obtained from these two methods are compared using the absolute errors. The result shows that RK4 gives better agreement and accuracy with the exact solution when compared to AM-RK4.

Keywords: biomechanical model; suspension system; numerical method

ABSTRAK

Suatu sistem regangan beg galas melibatkan persamaan pembezaan biasa telah dibangunkan dalam kajian ini. Kajian ini dijalankan dengan tujuan untuk menyelesaikan satu model biomekanik sistem regangan beg galas secara berangka. Model ini terdiri dari sistem badan dan beg galas yang diwakili oleh sistem spring-peredam menggunakan siri Fourier sebagai daya luaran untuk menerangkan pergerakan beg galas. Kedudukan dan halaju sistem regangan beg galas diperoleh menggunakan dua kaedah berangka, iaitu kaedah Runge-Kutta Peringkat-4 klasik (RK4) dan kaedah Runge-Kutta Peringkat-4 Min Aritmetik (AM-RK4). Penyelesaian berangka bagi kedua-dua kaedah ini dibandingkan menggunakan ralat mutlak. Keputusan menunjukkan bahawa kaedah RK4 memberikan nilai yang lebih baik dan jitu, dengan penyelesaian sebenar berbanding dengan kaedah AM-RK4.

Kata kunci: model biomekanik; sistem regangan; kaedah berangka

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