International J.of Multidispl.Research & Advcs. in Engg.(IJMRAE)
ISSN 0975-7074, Vol. 3, No. I (January 2011), pp. 107-128

IMPROVE HUNTING STABILITY OF RAILWAY CARRIAGE MODEL USING SEMI-ACTIVE LONGITUDINAL PRIMARY STIFFNESS SUSPENSION

KARIM H. ALI ABOOD AND R. A. KHAN

Abstract

Railway carriage mathematical model moving on tangent tracks is constructed by deriving the equations of motion govern the dynamic response of the model in which single-point and two-point wheel-rail contact is considered. The presented railway carriage model comprises of front and rear simple conventional bogies with two leading and trailing wheelets attached to each bogie. The railway carriage is modeled by 31 degrees of freedom which govern vertical displacement, lateral displacement, roll angle and yaw angle dynamic response of wheelset whereas vertical displacement, lateral displacement, roll angle, pitch angle and yaw angle dynamic response of carbody and each of the two bogies. Linear stiffness and damping parameters of longitudinal, lateral and vertical primary and secondary suspensions are provided to the railway carriage model. Combination of linear Kalker's theory and nonlinear Heuristic model is adopted to calculate the creep forces in which introduced at wheel and rail contact patch area. Computer aided-simulation is constructed to solve the governing differential equations of the mathematical model using Runge-Kutta fourth order method. Principle of limit cycle and phase plane approach is applied to realize the stability and to evaluate the concerning critical hunting velocity at which railway carriage starts to hunt. Numerical simulation model is used to study dynamic responses of the railway carriage components subjected to specific parameters of wheel conicity and primary suspension characteristics. Semi-active longitudinal primary stiffness suspension is investigated to improve hunting stability and increase the critical hunting velocity of the model. longitudinal primary semi active suspension is examined by the simulation railway carriage model to eliminate hunting instability of the system.

Keywords: railway carriage, conventional bogies, tangent tracks, semi-active suspension, longitudinal suspension, critical hunting velocity