World Academy of Science, Engineering and Technology
International Journal of Structural and Construction Engineering
Vol:13, No:07, 2019

Weak Instability in Direct Integration Methods for Structural Dynamics

Authors : Shuenn-Yih Chang, Chiu-Li Huang

Abstract : Three structure-dependent integration methods have been developed for solving equations of motion, which are second-order ordinary differential equations, for structural dynamics and earthquake engineering applications. Although they generally have the same numerical properties, such as explicit formulation, unconditional stability and second-order accuracy, a different performance is found in solving the free vibration response to either linear elastic or nonlinear systems with high frequency modes. The root cause of this different performance in the free vibration responses is analytically explored herein. As a result, it is verified that a weak instability is responsible for the different performance of the integration methods. In general, a weak instability will result in an inaccurate solution or even numerical instability in the free vibration responses of high frequency modes. As a result, a weak instability must be prohibited for time integration methods.

Keywords : dynamic analysis, high frequency, integration method, overshoot, weak instability
Conference Title : ICSE 2019 : International Conference on Structural Engineering
Conference Location : Paris, France
Conference Dates : July 18-19, 2019