SM12L_12682

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

On the Concept of “Dynamic (In)Stability of Quasi-Static Paths”

J.A.C. Martins[(1)], F.M.F. Simões[(1)], A. Pinto da Costa[(1)], I. Coelho[(2)]

(1) *Instituto Sup. Técnico, Department of Engineering Civil and ICIST, Lisboa, Portugal*
(2) *CMAF-UL, Lisboa, Portugal*

A concept of dynamic stability of quasi-static paths is proposed that takes into account the existence of fast (dynamic) and slow (quasi-static) time scales. A change of variables is performed that replaces the (fast) physical time t by a (slow) loading parameter λ, whose rate of change with respect to time, $\varepsilon = d\lambda/dt$, is decreased to zero. This leads to a system of dynamic equations defining a singular perturbation problem: the highest order derivative with respect to λ appears multiplied by ε. The proposed definition is essentially a continuity property with respect to the smallness of initial perturbations (as in Lyapunov stability) and loading rate ε (as in singular perturbation problems). Three mechanical examples (the Ziegler and Shanley columns and a pin-on-flat friction apparatus) are presented to illustrate similarities and differences between “dynamic stability of quasi-static paths” and Lyapunov stability of some related equilibrium configurations or dynamic trajectories.

View the extended summary