Dynamic Property Evaluation Based on Vibration Measurement and its Applications for Building Structures

Yoshiki IKEDA

Abstract

This research provides structural engineering with fundamental technologies to extract dynamic properties of building structures from their vibration measurements based on parametric system identification.

The first part proposes identification of story stiffness for MDOF shear/flexural-shear building models, identification of lumped masses for the shear building models, and identification of generalized Maxwell models. The newly proposed methods advance system identification in the time domain for MDOF lumped-mass models. The second part links system identification to damage detection, nonlinearity evaluation and response estimation. Its remarkable advantage is to require no mathematical models before implementation. The last part integrates system identification and active structural control. Active Mass Dampers directly use time series models of the controlled structures, and the control effectiveness is evaluated for each controller by closed-loop identification. In addition, the dynamic property of an actively controlled structure is understood deeply by applying many identification methods and comparing the results.

The proposed methods are verified by shaking table tests at E-defense in Kobe and vibration measurements of actual buildings. The verification contributes to fill a gap between theory and practice in the field of system identification. The research results become useful to confirmation of performance based design.