SUMMARY OF Ph.D. DISSERTATION

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Title

Identification of Dynamic Parameters of Buildings using Evolution Strategies based on Strong Earthquake Motion Records

Abstract

The purpose of the thesis is to contribute the progress of the seismic design of building structures by means of dynamic parameters estimated from strong motion records of actual buildings. To identify the dynamic parameters of dynamic models of buildings, non-linear optimization algorithms are adopted. The steepest descent algorism was applied to identify a natural frequency and a damping ratio of the first natural vibration mode of buildings. The evolution strategies (ES) algorithm was utilized to estimate parameters of the special models.

The chapter 1 briefly introduced the history of the strong motion observation and the research activities on dynamic characteristics of buildings in Japan. The purpose of the research in the thesis was also described in the chapter 1.

The chapter 2 explained basic analytical techniques in the thesis. The effectiveness of ES was substantiated in the chapter 2.

The chapter 3 introduced the activities on strong motion observation for buildings by Building Research Institute (BRI). The author belongs to BRI and is attending to the strong motion observation and related research work for more than 20 years. The thesis was written on the studies based on the strong motion records obtained from the BRI network.

The chapter 4 discussed the dynamic behavior of the BRI annex building. The building is densely instrumented with 11 acceleration sensors in the building and 7 sensors in the surrounding ground. The changes of the physical parameters of the building were minutely investigated using ES.

The chapter 5 statistically investigated natural periods and damping ratios of 25 buildings in the BRI network. The declining trends depending on the displacement amplitudes of the building response were recognized in all buildings.

The chapter 6 examined the non-linear response of a base-isolated building during a big earthquake in detail. The base isolation devices worked well in order to reduce the seismic force. The non-linearity of the base-isolated storey was evaluated by ES and compared with the theoretical equivalent stiffness and the damping ratio.

The chapter 7 concluded the thesis with a summary.