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Abstract

AMBIENT EFFECTS ON STRUCTURAL HEALTH MONITORING OF BUILDINGS

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Assessing the integrity of in-serve civil infrastructures via measurable dynamic information is known as structural health monitoring (SHM), which provide a platform for evaluating deteriorations and diagnosing damages. Hence, preventive and corrective maintenance decisions can be made judiciously at the earliest possible stage to ensure the safety and serviceability for further commercial and residential usages.

This study actualizes SHM by utilizing full-scale field measurement of a reinforced concrete building via the Bayesian probabilistic framework. A Bayesian frequency domain approach is introduced for identifying the modal parameters of a dynamical system. One essential feature of this approach is that it can determine not only the optimal estimates but also their associated uncertainties, which breaks through the restriction of usual identification algorithms that only provides the former. Simulative and laboratorial examples are used to demonstrate the flexibility and robustness of the proposed approach. After the parametric identification methodology is ready, the next step is to move on the core part, realistic civil engineering SHM applications.

A funded SHM project of the University of Macau has started to manipulate for investigating the structural dynamic behavior of a 22-storey student dormitory since May 2, 2008. By employing the incomplete noisy measurements, two critical issues in SHM are elaborated on. The first issue refers to analyzing the structural behavior under violent tropical cyclone excitation. Immersing in such a significant blusterous environment, temporary and permanent changes of the building can be interpreted

by the variation of the identified modal parameters. Moreover, the aerodynamic-structure interactions are also discussed.

The second issue focuses on discriminating ambient inferences from inherent variations of the dynamic system. Regarding one-year daily monitoring measurements, Bayesian model class selection approach is applied to choose the most plausible model for describing the relation between ambient conditions and modal parameters. Therefore, the ambient inferences become quantitative and discriminative.

As a whole, a valuable basis to execute reliable and consistent judgment on structural health is provided in this thesis.