SUMMARY OF Ph.D. DISSERTATION

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Title

Damage Diagnosis of Infrastructures Using Support Vector Machine Focusing on Variance and Complex Fourier Components

Abstract

In this dissertation, the feature extraction method considering the variance information of complex Fourier components and the damage diagnosis method using pattern recognition are proposed. Feasibility of proposed methods are investigated for two examples that are the concrete strength estimation by drilling tests and the water leakage detection based on acoustic method.

Chapter 1 introduces the background and the review of the previous studies. The ability of the feature extraction based on the variance information is discussed. The algorithm of the proposed system and the objective and the contents of this dissertation are described.

Chapter 2 presents the possibility of the classification system using the first and second order statistical moments applying to the concrete strength estimation by drilling tests. The mean values and standard deviations of collected drilling data are calculated. Among them, the highly correlated parameters with concrete strength are extracted and used as the features to build the classifier. Two classifiers built by multiple regression analysis and Support Vector Machine (SVM) are compared.

Chapter 3 discusses the application of the proposed method in the previous chapter to the water leakage detection. The variances of Fourier components between frames obtained through STFT are used as the features to build the SVM and the classification performance are considered.

Chapter 4 proposes the feature extraction based on Principal Component Analysis (PCA) to represent the distribution shape of the frequency variances. The PCA parameters obtained from the amplitude, real part and imaginary part of complex Fourier components are used as the features to build SVM. To obtain the variance of complex components stably, the examples of complex numbers are considered. Based on it, the Multi-shift-frame STFT, which can consider at least one wavelength before shifting, is proposed. The SVMs are built by the features which are extracted through STFT and Multi-shift-frame STFT. The classification performance, stability, applicability and reliability of built SVMs are compared.

Chapter 5 concludes this dissertation. The proposed damage diagnosis method considering the variance of complex Fourier components can be considered to accomplish the reliable automatic damage diagnosis.