Error analysis of structural system identification by observability method

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Abstract

In structural system identification, measurement errors and simulation errors are closely related with the accuracy of the identification method. In this paper, the effects of these two types of errors on structural system identification by observability method(OM) are thorougly discussed. An example structure is analyzed step by step. For the very first time, the analytic expression of the flexural stiffness is given by the observability method. Using this expression, the effects of errors in a particular measurement, random errors in all measurements are analyzed. Also, two examples are used to illustrate the effect of simulation errors of observability method. It is observed that the estimations fluctuate during the recursive process. Also, the accuracy of the estimations decreases sharply at null curvature zone. For this reason, it is highly recommended to adopt different load cases to alleviate this situation.

Keywords: structural system identification; observability method; static; measurement errors; simulation errors;

1 Introduction

The deterioration of structures might lead to their failures. One typical way to prevent such accidents is to use structural system identification (SSI) to estimate the structural parameters ([1]). Based on the excitation, SSI can be categorized as static[2] and dynamic([3]). Static SSI methods identify the stiffness of the structures using static response. Dynamic SSI methods can also identify the change in mass and damping parameters. In some cases, identification of stiffness is sufficient for condition assessment. Also, static measurements have higher accuracy than dynamic measurements. Hence, static SSI methods might be preferred in these cases ([4]). According to whether the system of equations has a physical meaning or not, SSI methods are classified as parametric or non-

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