MATERIAL PARAMETER IDENTIFICATION OF AN ELASTIC PLATE USING DYNAMIC BENDING RESPONSES

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Abstract

Recently, computational approach to the inverse problems has been attracting attention [1]. This paper is concerned with application of an inverse analysis method to identi¯cation of unknown material constants of an elastic plate using dynamic bending responces. The extended Kalman ¯lter and the boundary element method are combined to use for the inverse analysis [2]. The extended Kalman ¯lter algorithm can estimate state variables of a stochastic system. It is expected that the algorithm is also applicable to analysis of other identi¯cation problems for which noisy data are available at a limited number of measuring points. The method of inverse analysis is applied to several examples of this parameter identi¯cation problem, and the numerical results obtained are discussed.

For numerical simulation, we consider a circular plate with all edge clamped, which is subjected to a known dynamic concentrated load at the center point of the plate. It is assumed that the lateral displacement is measured at the center point of the plate and also several points in time domain. Covariance of measurment errors and the target values of material constants are assumed,

respectively, such that R = 10^{i6}I[m^2] ; Target values: E = 2:0 £ 10^{11} [Pa]; ½ = 7:8 £ 10^3 [kg=m^3].

Table 1 shows the estimated material constants when two observed data in time domain are used. Numerical values shown in parentheces in the table indicate percentage errors of estimations. Table 2 shows similar results when four observed data in time domain are used. It can be seen that estimation is improved if the number of observation points in time is increased.

Table 1: Estimated results on material constants of circular plate under two observation points in time

Initial		Estimated	
E [Pa]	½ [kg=m^3]	E [Pa]	½ [kg=m^3]
1:4 £ 10^{11}	5:46 £ 10^3	2:143 £ 10^{11} (7:188%)	8:129 £ 10^3 (4:220%)
2:6 £ 10^{11}	10:14 £ 10^3	2:204 £ 10^{11} (10:244%)	8:534 £ 10^3 (9:411%)

Table 2: Estimated results on material constants of circular plate under four observation points in time

Initial		Estimated	
E [Pa]	½ [kg=m^3]	E [Pa]	½ [kg=m^3]
1:4 £ 10^{11}	5:46 £ 10^3	1:963 £ 10^{11} (¡ 1:824%)	7:707 £ 10^3 (¡ 1:182%)
2:6 £ 10^{11}	10:14 £ 10^3	1:963 £ 10^{11} (¡ 1:821%)	7:707 £ 10^3 (¡ 1:180%)

It can be concluded that the present method of inverse analysisis is rather robust even if measurement errors are included.

References

[1] Tanaka, M. and Dulikravich, G.S. (Eds.)(2001) Inverse Problems in Engineering, Elsevier Science.

[2] Tanaka, M. (1999) Inverse Problems in Engineering { Theory and Practice, ed. K.A. Woodbury, Engineering Foundation and ASME, pp.9{18.