



L_1-Regularization Technique for Damage Detection in Time Domain

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ABSTRACT: This paper presents a system identification (SI) scheme in time domain using measured acceleration data. The error function is defined as the time integral of the least square errors between the measured acceleration and the calculated acceleration by a mathematical model. Damping parameters as well as stiffness properties of a structure are considered as system parameters. The structural damping is modeled by the Rayleigh damping. The regularization technique is adopted to alleviate the ill-posed characteristics of inverse problems. A new regularization function defined by the L_1-norm of the first derivative of the system parameters with respect to time is proposed to accommodate discontinuous system parameters. The truncated singular value decomposition is employed to filter out noise-polluted solution components in quadratic sub-problems of the error function. The regularization function is imposed as a separate optimization problem in each quadratic sub-problem. The optimization of the 1-norm is performed by the simplex method. The validity of the proposed method is demonstrated by an experimental study on a shear building model.

KEYWORDS: System Identification in Time Domain, Acceleration, Regularization, Simplex method, Truncated Singular Value Decomposition and Rayleigh Damping