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ROBUST CHANGE DETECTION PROCEDURE WITH APPLICATION IN STRUCTURES MONITORING SUBJECT TO SEISMIC MOTIONS

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Abstract. *This paper puts forward a robust change detection procedure, which is able to analyze the transient seismic motion and the vibration structure response, as well as to determine the changes in the amplitude and frequency content of the structure. This technique makes use of an impulse invariant transformation that will enable us to obtain an equivalent model of the vibration structure, represented by a parallel-form realization of single-degree-of-freedom oscillators that correspond to different vibration modes while a stationary independent and identically distributed signal stands for input. The method is applied to change detection in dynamic characteristics of a structure, a multi-story concrete building subject to a strong seismic motion.*
Keywords: AR processes, Deconvolution, Detection, Filtering, Frequency response, Parameter estimation, Seismic signal processing.

1. **Introduction.** The problem of change detection and isolation has received great attention during the last two decades, in the research context and in the applications on real systems, [1]. The change detection schemes, proposed for dynamical systems with various change modes, make use of identification and estimation methods. In this case the problem is to construct an effective detection index, sensitive to the changes in the models, identified for different input-output data sets. Such an index may be Kullback Discrimination Information (KDI), known as a distorsion measure to compare two probability density functions, [2].

Using the parameter estimation approach, the change detection problem can be stated as follows, [3]: Let us consider two data sets I_n and I_c available. The data set I_n is a nominal data set obtained under a non change condition, and the data set I_c arises from a data set with a possible change in the system. The data are assumed to originate from a system given by:

$$y(t) = G(\theta(t))u(t) + v(t) \tag{1}$$

where

$$\theta(t) = \begin{cases} \theta_n(t) & \text{, for } I_n \text{ data set} \\ \theta_c(t) & \text{, for } I_c \text{ data set} \end{cases} \tag{2}$$

G is a transfer function, discrete or continuous, and $v(t)$ is a term describing the disturbances and the noise.

The problem can be now stated as deciding which of the following two hypothesis H_0 and H_1 defined below, is true.