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A.L. Araújo, C.A. Mota Soares, et al. (Editors)

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DAMAGE DETECTION IN STRUCTURES USING ROBUST BASELINE MODELS

[1]Jhonatan Camacho, [1]Magda Ruiz, [2]Rodolfo Villamizar, [1]Luis Eduardo Mujica Delgado, [3]Fernando Martinez

[1]Department of Applied Mathematics III, Escola Universitària d'Enginyeria Tècnica Industrial deBarcelona (EUETIB), Universitat Politécnica de Catalunya (UPC) BARCELONATECH
jhonatan.camacho@estudiant.upc.edu ; magda.ruiz@upc.edu ; luis.eduardo.mujica@upc.edu,

[2]Escuela de Ingenierías Eléctrica, Electrónica y de Telecomunicaciones (E^3T), Universidad Industrial de Santander, Colombia
rovillam@uis.edu.co

[3]Department of sensors, Ikerlan Research Center, Spain
fmartinez@ikerlan.es

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Summary: This work deals with a previously proposed piezo-diagnostic methodology based on principal component analysis for structural damage detection. Previous works have demonstrated the effectiveness of baseline models to distinguish between structural damage and undamaged conditions, however, its robustness and reproducibility depends on a proper estimation of the principal components from undamaged data matrix measurements. Principal components are highly sensitive to the algorithm parameters used to compute the singular value decomposition, on the number of experiments collected for building the baseline model and on atypical measurements. In this work, the above conditions are studied by including a pre-processing state using time feature extraction in order to solve the ill-conditioned statistical problem due to the low ratio between undamaged cases and time piezo-electrical samples used for building the baseline model. In addition, a comparison between two methods (Proper Orthogonal Decomposition Vs NIPALS) used to estimate the principal components is done. Average of several experiments is computed to deal with atypical data cases and experimental results are obtained from two structures: i.) a carbon steel pipe section and ii.) a laboratory tower that mimics a wind turbine. Finally, damages are conditioned in order to produce leaks in the pipe section and a crack in one element of the laboratory tower