

## DAMAGE DETECTION IN 4-STORY STEEL BRACED FRAMES USING RESIDUAL FORCES BASED ON WAVELET TRANSFORM

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### ABSTRACT

Wavelet transform, which was first introduced in 1980, is operating on a modified basis functions and makes them a new function. Wavelet analysis capability using a new method to analysis the signals and time-frequency signal processing offers. By replacing the wavelet network rather than rigorous analysis, accurate operation will not reduce the computational time is reduced dramatically. (Roland, 2000). Wavelet analysis is an efficient tool to detect structural damages like cracks and stiffness degradation (Kim and Melhem, 2004).

In this study, residual forces and damage detection procedure by wavelet transform of residual forces were described. A four story space frame with diagonal braces with several damage states was considered. For every state of damage mass and stiffness matrices, mode shapes and natural frequencies were evaluated. Finally dynamic responses of structure were conducted under wavelet analysis and for all cases, damages were successfully detected.

After wavelet analysis on responses, wavelet analysis curves of residual forces showed peak points on degree of freedoms of damaged members.

The damage locations, when damage occurs, are easily determined simultaneously by the ridges in the residual forces based on wavelet transform. The degrees-of-freedom that have large magnitudes in residual wavelet force (RWF) are associated with the potential damage members within the structure.

### INTRODUCTION

During last decades ways of detection mechanical and structural structures damage has got a lot of attention. Wavelet analysing, a relatively new mathematical relation and a mean of signal processing, is one of the ways which is studied recently. Analysing time-frequency give more detailed information regarding unstable signals which February series can't do. This has been used in various fields like Civil engineering, Mechanic and Aerospace, for recognizing diminishing and controlling the structure health (Kim and Melhem, 2004). Hasang Kim and Hani Melhem (2004), categorized the ways of collapse recognizing through using wavelet into three levels: 1- wavelet amounts variations 2- local disturbance of wavelet amount in a short time. 3-reflections wave created by local collapse. The first level is usually used if there is any collapse and the intensity of that; the second level is used to determine the place of collapse, and the third level is used to determine the intensity and exact place (Kim and Melhem, 2004). Fan and Qiao used the continuous to dimensional wavelet of mode shapes to determine the damage in planer structures. The suggested algorithm, is a response which is based on collapse recognizing method and only needs the mode