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STRUCTURAL DAMAGE QUANTIFICATION BASED ON RECURRENCE PLOTS AND RELAXATION METHOD OF PARTICLE FILTER

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Summary: Deterioration of the structure often refers to the structural damage and it can be reflected by the "deterioration" of the structural parameters. In practice, damage was defined as the changes introduced into a system which adversely affected its current or future performance. Therefore changes in structural parameters have been extensively applied as effective tools for damage detection. Among which, the vibration-based damage identification methods draws extensive attention and are deeply developed.

The deterioration of the civil engineering structures usually begins from the local and small damages. Small damages gradually develop and become large damages and at last cause failure of the structure. For the consideration of the structural safety and reliability, detecting small damages is essential and useful. Therefore, to detect minor damages, development of other approaches is necessary, in which chaos attractor-based analysis seems to be a promising way.

A first attempt is made in this study to explore an attractor-based health monitoring system using chaotic excitation for the purpose of the damage localization. In evaluation of reconstructed attractor, the recurrence plot is applied to detect damage-induced change. However, detection alone may not be sufficient for the purpose of damage evaluation and structural maintenance. In this case, damage requires to be further quantified.

The second attempt is made to identify the structural parameters by using particle filter for damage quantification.

Laboratory experiment using a 4-story building subjected to chaotic excitation is conducted. The experimental results demonstrated that the proposed approach will be helpful for detecting and evaluating damages at the early stage for the structural health monitoring.