



# Damage detection based on Null-subspace analysis

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## 【Background】

For the purpose of online structural health monitoring, quick and accurate state estimation of monitored structure is necessary. However, traditional modal parameters based damage detection methods are not sufficiently sensitive to reflect damage levels, even including the loss of prestress. What's more, it's hard to comprehensively analyze all the modal parameters to judge whether the structure is healthy or not when real-time SHM.

## 【Objective】

This study aims to find a method that is sensitive to the damage levels of structures and easy to analysis for the purpose of real time SHM. In addition, a damage indicator that can reflect the healthy condition of the structure is investigated, which can also reflect prestress breakage.

## 【Approach】

Starting from the point of subspace analysis, a damage detection method based on Null subspace analysis is proposed. Due to the orthogonal relationship between the subspace and Null subspace of the Hankel matrix which is composed directly of the collected acceleration data, once the structural state changed, the orthogonal relation will not be satisfied. Based on the relative changes of orthogonal relations, a damage indicator is derived from the Hankel matrix to reflect the health condition of the structure.

## 【Publication plan】

- One journal paper for ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part A: Civil Engineering.
- ICOSAR, 20-24 June, 2022, Shanghai.

## 【Results】

A damage indicator derived directly from the Hankel matrix which is composed of acceleration data is proposed, which shows high sensitivity to damage levels and can also reflect the losing of prestress.

