Damage Identification Using Data Assimilation And Machine Learning Techniques

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ABSTRACT

Damage is a main cause of structural failure and often occurs on structures. Special attention must be given to avoid the sudden failure of structural components; the objective must be not only to detect the presence of damage in structures but also to identify its location in the early state. Real-time decision-making is therefore needed.

One could expect that the correlation between displacements, velocities or accelerations, strains or energies, are different inside and outside the damaged region. Thus, by applying an appropriate classification strategy one could expect separating nodes located inside and outside that area.

However detection is not equally sensible to all the problem outputs, it seems that strain, that is expected being discontinuous across the damaged area boundary, is particularly appropriate to be used by a classifier. In this work we compare different classifiers operating on different variables.

The main difficulty when considering the approach discussed above is that the different fields are needed in as many location as possible. Having access to all this local information could become prohibitive in practical applications. Thus, we consider data acquisition in few locations (appropriately chosen), and then assimilated the fields from this reduced amount of data. In this work we compare different assimilation techniques.

Finally, we compare the health monitoring performed by using machine and manifold learning strategies with more experienced state-of-the-art techniques based on the use of wavelet analysis on the assimilated fields or on the empirical modal analysis.

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