

Inverse Problems Network Meeting 1

Monday, 24th April 2017 - Tuesday, 25th April 2017

WX/3.14, Queens Buildings, Cardiff University

Abstract of Talk

DETECTION OF MULTIPLE DAMAGE IN STRUCTURES USING NATURAL FREQUENCY DEGRADATIONS

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Non-destructive measurement of natural frequencies provides a simple means of detecting the location and severity of damage in a structure through changes in its eigenvalues. Further information is provided by changes in vibration modes (i.e. the eigenvectors), but this requires a scan of the whole structure which may be impractical for in situ assessment. Eigenvalue changes for a single occurrence of damage give a "damage signature" which can be expressed analytically and normalised so that its components are functions of the damage location but are independent of its severity. Thus, by using measured natural frequencies from the structure before and after the occurrence of damage, the location is found by solving an inverse problem, and then the severity is determined by comparison with the unnormalised damage signature. Noise in measurements can be accounted for by using a least squares search and/or interval arithmetic. If there are n occurrences of damage, the inverse problem entails a search for n damage locations and n parameters representing the damage severity. The degradations in any n of the natural frequencies are used to isolate the severity parameters, and then the remaining degradations are used to identify the locations. Preliminary results will be presented for the detection of multiple cracks in beams and frame structures.