IMPLEMENTING IMPEDANCE – BASED HEALTH MONITORING

by

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ABSTRACT

This work is an experimental study of applying an impedance-based health monitoring technique to complex structures. The work is presented in three parts.

In the first part we consider effects of the following three factors on damage detection abilities: actuator excitation level, test wire length and ambient conditions (temperature, structural loading and vibration). It was concluded that increasing the applied voltage improves the signal to noise ratio and damage detection abilities. Test wire lengths under 30m do not affect damage detection abilities. The technique is able to distinguish and detect damage even with variations in temperature, structural loading and vibration.

In the second part we apply our health monitoring technique to a complex truss structure and a massive steel steam header. We discovered that with multiplexing (acquiring a single signal from distributed actuators) the actuators on the truss structure we could detect damage but with less location information. Damage detection on the steel pipe ended in inconclusive results. The use of this technique on massive structures needs further investigation.

Finally, we conducted a detailed experimental study of monitoring the integrity of composite-reinforced masonry structures. We developed a software package which enables even a casual user to determine if significant damage has occurred in these structures. The technique was successfully applied to detect damage (particularly due to

delamination) in these composite-concrete structures. Most significantly, the technique was also able to detect damage well in advance of actual failure.

This work relies mainly on frequency response plots and damage metric charts to present the data and to arrive at any conclusions. While frequency response plots give a qualitative approach to the analysis, damage metric charts attempt to quantify the data.

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