

Development of a Compact Multi-Sensor System for crack detection in Structures

We propose to design, develop and test a small portable system for detecting cracks/flaws in critical structures. The multi-sensor system is a linear array of small coils, excited by an alternating current source. The operational principles of the sensor is based on electromagnetic induction. The sensor induces eddy currents in the structure which is interrupted by cracks. Hence, the impedance of each coil in the array changes when it encounters a flaw in the specimen. The coil impedance can be measured to determine the presence of a crack in the structure.

The system that we propose to build should be capable of measuring these small impedance changes in each of the coils in the array. One of the options is to use high precision impedance converters such as the Analog Devices AD5933, multiplexed appropriately, to measure the impedance changes. The device provides a digital output that can be sampled by an iPhone. In order to make the system more useful for users, we need to develop software for processing the signal from the transducer. As an example, digital filters need to be implemented via software to improve SNR and derive information from the signals. Other functions such as rotation, scaling and biasing also need to be implemented via software to improve our ability to interpret the signal and draw conclusions about the nature of the defect. The system needs to be designed to accommodate absolute, differential and transmit/receive eddy current transducers. The goal is also to reduce the size of the instrument using state-of-the art devices to improve portability.

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Sponsor: Dyson Foundation