Recent Trends on Condition Monitoring using Electromagnetic Measurements

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Over the decade, electromagnetic measurement techniques such as eddy current test, magnetic leakage field inspection, have been one of the key components in quantitative nondestructive evaluations (QNDE) in variety of industrial applications. The advantage of electromagnetic device involves the remote capabilities and rapid processing in measurements. Moreover, with the background knowledge of the well-defined forward analyses for electromagnetic nondestructive evaluation (ENDE), various data mining techniques, such as damage reconstruction and early detection of incipient damage, have been proposed and successfully accomplished in part.

Recent issues on global low carbon society have attracted attention in new maintenance philosophies for keeping safety operation of power plants. Condition based maintenance (CBM) has some advantages on improving system reliability and decreasing human error influences. Since CBM is based on real time data utilization in order to optimize maintenance resources. Condition monitoring (CM) is observing the system state for the purpose of monitoring structural health and activated whenever maintenance is actually required. CM plays in essential roles in developing extensive instrumentation of measurement equipments and together with better performance for analyzing condition data. Taking into account those circumstances, in this lecture, we discuss how to contribute current NDE to CM based on electromagnetic measurements.

In the second part of the lecture, monitoring for pipe wall thinning using electromagnetic acoustic transducer (EMAT) is introduced as a typical example of condition monitoring system. The proposed system provides no contact, highly resolvable measurements, and remote capability of inspection procedures. The precise measurements using electromagnetic acoustic resonance method (EMAR) were verified both for calibration test specimens of carbon steels (SS400) and for test specimens fabricated to simulate FAC damage. The proposed method was also applied to the downstream of elbows or orifices at the real plant and verification tests were implemented using the standardized inspection method. The several critical issues are shown for practical implementation in on-line monitoring.

The final part of the lecture is devoted to the future developments for hybrid sensing which allows us multi-scale NDE using electromagnetic measurements. We introduce an accurate sizing methodology provided with multi-physics information using a single sensor.