DESIGN OF LOCAL SHM SYSTEM MODEL FOR POWER PLANT PIPELINES

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Structural Health Monitoring (SHM) becomes an important emerging technology, improving reliability and safety of highly stressed structures, and supporting their effective maintenance, and lifetime. The use of SHM systems has the potential to provide greater confidence in the integrity of a structure part. The SHM in nuclear or classical power plant pipelines exploits a link stress history, and damage evolution. Design and testing of a small model of local SHM system specific for monitored structural parts is described in this paper. The primary goal of structural part monitoring is to enable detection and classification of any state or behavior changes that could deteriorate the function and reliability or jeopardize safety of that part or its interconnections. Each local SHM uses its own NDT/E sensor network for specific damage diagnosis allowing damage detection, location, and definition of its type and extent. The process of SHM involves continuous monitoring of the structure using appropriate sensors, extracting damage sensitive features and analyzing that features to determine current state and reliably estimate remaining lifetime. Damage features from monitoring are compared with simulation models, structure history, and computed design parameters with standard safety regulation codes. It will allow predicting damage progress and judging whether the predicted progress exceeds the safety. Because of limited laboratory conditions, the functionality of complex SHM model system is demonstrated on relatively simple tube samples with initial defects tested by fatigue loading representing various degradation phenomena including leakages (LBB strategy). The model samples are fitted by a) optical cables with Fiber Brag Gratings for measurement of temperature, strain, and low frequency vibrations, and b) by appropriately spaced piezoelectric transducers used for sensing and exciting elastic waves in a frequency range 50 to 500 kHz. Piezo-transducers are mounted on waveguides welded on the tube, which allows simulate their use under higher temperatures. The installed piezo-transducers switched by multiplexor in transmitting or receiving modes are commonly applied in various ultrasonic NDT/E methods: 1. Acoustic emission; 2. NEWS (four procedures); 3. Coda-wave interferometry (CWI); 4. Guided wave dispersion mode analysis (GWI). All those methods are controlled by small PXI system with data acquisition and arbitrary waveform generator modules, completed with power amplifier. Online evaluated data obtained by recording different physical quantities are compared with stored history of stresses and parameters of existing flaws. Structure part integrity assessment based on correlation between data and interpretation with the aid of AI (Convolutional Neural Networks). Real conditions on power plant are simulated on Digital Twin of tested part.