Development of multi-channel magnetic flux leakage testing system for bridge cables

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Magnetic flux leakage (MFL) is one of the most popular techniques for detecting broken wire in bridge cables. MFL sensor array has attracted a lot of attention in recent years due to its capacity to measure the spatial distribution of the magnetic field of bridge cable. More sensors in the array lead to increased useful information extraction from the MFL field, allowing for more precise quantitative evaluation of bridge cable damage. This study reports the development of a cable MFL detection system capable of synchronous acquiring up to 512 channels of MFL sensors signal. Radial sensor arrays (RSA) composed of vertically placed magnetic sensors spaced at equal intervals are developed to be arranged around the bridge cable. They record the spatial distribution of the magnetic leakage field of the broken wire by collecting the MFL signal at various lift-offs. To solve the problem of multi-channel MFL signal synchronous acquisition, this study develops a MFL signal acquisition card based on multiplexing technology, capable of synchronous acquisition of up to 512 channels of MFL signal. Multiplexers are used to switch sensor channels, followed by multi-channel A/D conversion chips to convert the transmitted data. The converted data are temporally stored in the First-In-First-Out (FIFO) buffer of the Field Programmable Gate Array (FPGA) and transferred to the computer through the network port for display, storage, and signal processing. Finally, the motion control circuit, mechanical structure, and control software of the bridge cable MFL detection system are fully customized. Experiment results reveal that the system can be used in multi-channel MFL testing, laying the foundation for further multi-channel signal processing and bridge cable health evaluation.