

Principle of the electromagnetic testing based on the varied frequency domain and its realization

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With the development of modern industry, the types and quantities of industrial equipment are increasing. In the long-term production process, various failure modes such as corrosion and cracks will occur, therefore the workload of inspection will increase dramatically. It is extremely urgent to study the combined non-destructive testing (NDT) technology and develop corresponding multi-functional instruments to achieve rapid inspection. In this paper, an electromagnetic testing principle based on the varied frequency domain is proposed. In the first place, spatial uniformity and spatial periodic static fields are generated by the arrangement of the permanent magnetizers, these static fields distribute in different spatial frequencies. In the second place, dynamic magnetic fields with different frequencies are generated by different frequency current excitations. Under the time-space electromagnetic field coupling, a new combined electromagnetic testing principle of magnetic flux leakage (MFL), guided wave (GW) and electromagnetic acoustic transducer (EMAT) is proposed. The MFL testing method can be realized based on the uniform static field, GW based on the interaction of spatial periodic static field and low frequency dynamic field, while EMAT based on the combination of uniform static field and high frequency dynamic field. According to the above principle, a multi-functional instrument is developed, which includes a medium-low frequency excitation unit for GW, a high frequency excitation unit for EMAT, corresponding receiving amplifiers for GW/EMAT/MFL, and USB-based data transmitters. Finally, the relevant performance tests are carried out, which laid the foundation for field applications.