Pattern Deep Learning of Natural Cracks Diagnosis System based on Novel L-shaped Electromagnetic Sensing Thermography

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Nondestructive detection of small fatigue cracks is a critical and challenging task in evaluating the properties of material. This paper proposes a novel L-shaped ferrite magnetic open sensing structure of eddy current pulsed thermography (ECPT) system for micro fatigue cracks inspection on metallic materials with anomalistic geometry. The theoretical derivation model of the proposed structure is developed to generate a guided distribution of electromagnetic field for enhancing the weak thermal signal detection. In particular, it integrates both time and sequences compressing and normalization with spatial pattern deep learning for crack information detection. Thus, an physic-mathematic end-to-end pattern deep region learning structure to achieve precise crack detection and localization has been proposed. The proposed detection model provides a region of interest which has relative uniform magnetic field as well as conducting an intelligent decision. This significantly enhance the detectability and thermal contrast of omnidirectional micro fatigue cracks. In addition, the detection is completely in the open view of the infrared camera and the configuration has advantages of dramatically increasing portability and efficiency for detecting complex workpiece. Experiments on natural cracks in several samples have been conducted to validate the reliability and efficiency of the proposed system as it lies in a region sensing with relatively high uniformity and eddy current intensity.