A low-frequency Eddy current probe based on miniature fluxgate array for defect evaluation in steel components

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ABSTRACT

Detecting defects in high-permeability steel components can be challenging when using the eddy current technique. This is due to the strong magnetization signal that is simultaneously generated along with the eddy current signal. To minimize the regions of the induced eddy current and its detection, an eddy current probe based on an array of miniature fluxgate sensors (DRV425; Texas Instrument, USA) and axial inductors was proposed and fabricated in the study. The fluxgate sensors were arranged in two layers, and the sensors were sandwiched between two layers of inductors. The output signals from the fluxgate array were sampled to obtain a differential signal of the eddy current intensity and direction. A phase-sensitive detection technique was implemented to isolate the strong magnetization signal from the detected eddy current signal and utilized to characterize artificial slits with varying depths. The developed probe successfully characterized both the vertically and horizontally oriented slits with depths from 2 to 10 mm on a 12 mm-thick mild steel plate. A better sensitivity was notable in the evaluation of the vertical slits where the vertical slits would increase the eddy current intensity in contrast to the horizontal slits around the slits. It was shown that the eddy current's distribution map obtained from the developed probe could be used to reveal the physical dimension of the slit.

KEYWORDS

Crack; Defect; Eddy current testing; Steel; Fluxgate

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