Analysis of the resolution of the passive magnetic method on the example of nondestructive testing of steel wire ropes

Paweł Mazurek,[1] Maciej Roskosz,[1] and Jerzy Kwaśniewski[1]

[1] *AGH University of Science and Technology*

Early identification of micro defects in steel wire ropes significantly impacts structures' in-service reliability and safety. The analysis of the possibility of using the passive magnetic technique in diagnosing steel wire ropes is the subject of ongoing research [1], [2]. The self-magnetic flux leakage (SMFL) method is a passive variant of the magnetic flux leakage (MFL) method [3]. The main difference is that the SMFL method relies on the self-magnetization of ferromagnetic material in a geomagnetic field, while the MFL method requires an externally formatted excitation source [4]. Some authors [5] emphasize that a significant threat to this method is the influence of the magnetic force of the neighbouring elements of the tested object, which can effectively suppress the diagnostic signal. Magnetic signal inspection based on the self-magnetic flux leakage (SMFL) effect can effectively identify the location of defects. However, current research on the magnetic signal of defects under the influence of various factors needs to be more comprehensive. In [6], the authors proved that the damage depth depends on the diagnostic signal's amplitude. This method is the subject of intense research. However, no paper was found that compared different distances between discontinuities and their magnetic signatures. This work aims to analyze the resolution of the passive magnetic method on the example of defect tests of steel wire ropes. The research was conducted with sensors using the following phenomena: magnetoimpedance (MI), tunnelling magnetoresistance (TMR), and optically pumped magnetometers (OPM). The article aims to indicate the most appropriate sensor that best shows the modelled failure description as a beginning for further calculation diagnostics algorithms.

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