Pitting Corrosion Analysis of Potential Matrix Mapping based on Finite Element Method

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Abstract. Potential Matrix Mapping (PMM) represents a novel corrosion monitoring technique that exhibits high accuracy and sensitivity. It is currently employed extensively in the online monitoring of corrosion in energy equipment. Its primary principle is to assess the corrosion of the internal wall of a metal structure by measuring the voltage change on its surface(Corcoran et al., 2020 , Ho et al., 2019). However, in the pitting corrosion signal analysis and inversion, the accuracy of the pitting corrosion morphology parameter detection is not sufficiently high(Gan et al., 2016). This paper proposed a calculation and analysis of the relationship between different pitting topography parameters and detection signals, based on the finite element method. A mathematical model and inversion algorithm for mapping between pitting morphology parameters and electric field characteristic signals have been established through multiple regression analysis and a neural network optimized based on a genetic algorithm. The issue of accurately resolving pitting morphological parameters has been resolved. The results of the numerical simulation and laboratory validation showed that both methods are effective in improving the computational accuracy of pitting signals in the PMM inspection technique. The algorithm based on multiple linear regression is more straightforward to implement, whereas the neural network-based algorithm exhibits a significantly lower relative error, with a relative error of less than 3% in its resolution of the pitting parameters. The aforementioned research offers a theoretical and technical foundation for the industrial implementation of PMM technology.

Keywords. corrosion monitoring; numerical simulation; PMM; data Inversion

Reference

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