Image recognition for lifetime prediction of organic coatings in the deep-sea environment

Fandi MENG[1], Jianning CHI[2], Yufan CHEN[1], Li LIU[1]

[1] *Corrosion and Protection Center, Northeastern University, Wenhua Road 3-11,Shenyang, 110819, China PR*

[2] *College of Information Science and Engineering, Northeastern University, Wenhua Road 3-11,Shenyang, 110169, China PR*

fandimeng@mail.neu.edu.cn

Abstract The rapid failure of organic coatings in deep-sea environments complicates accurate lifetime prediction [1, 2]. Given the rapid cracking characteristic on the coating surface in this environment, a comprehensive “performance-structure” failure model was established. Image recognition technology is used to extract information from SEM images of epoxy mica coatings serving for different periods of time in the simulated deep-sea fluid-pressure environment. A targeted approach containing convolutional neural networks and post-processing has been established for the crack area detection of coating surface. The length distribution and the statistical evolution of cracks were summarized, to obtain the kinetic equation of the cracks related to coating structure degradation. Based on this achievement, a comprehensive failure model combining coating properties and coating structure degradation is developed. The relative weights of three dominant factors in coating failure, including water diffusion, coating adhesion, and crack length were calculated by the gray relational analysis method. A relatively accurate prediction of coating lifetime was performed through the established “performance-structure” failure model.

Keywords image recognition, organic coatings, deep ocean

Reference

[1] F. Meng, L. Liu, E. Liu, H. Zheng, R. Liu, Y. Cui, F. Wang, Synergistic effects of fluid flow and hydrostatic pressure on the degradation of epoxy coating in the simulated deep-sea environment, Progress in Organic Coatings, 159 (2021) 106449.

[2] N. Fredj, S. Cohendoz, X. Feaugas, S. Touzain, Ageing of marine coating in natural and artificial seawater under mechanical stresses, Progress in Organic Coatings, 74 (2012) 391-399.