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Learning to Reconstruct Crack Profiles for Eddy Current Nondestructive Testing

Enrui Zhang

Eddy current testing (ECT) is one of the most popular Nondestructive Testing (NDT) techniques, especially for conductive materials. Reconstructing the crack profile from measured EC signals is one of the main goals of ECT. This task is highly challenging, as the EC signals are nonlinear responses resulted from the presence of cracks, and reconstructing the crack profile requires establishing the forward model of the nonlinear electromagnetic dynamics and solving its inverse problem, which is an ill-posed numerical optimization problem. Instead of solving the inverse problem numerically, we propose to directly learn the inverse mapping from EC signals to crack profiles with a deep encoder-decoder convolutional neural network named EddyNet. EddyNet is trained on a set of randomly generated crack profiles and the corresponding simulated EC responses generated from a realistic forward model. On the held-out test data, EddyNet achieved a mean absolute error of 0.198 between predicted profiles and ground truth ones. Qualitatively, the geometries of predicted profiles are visually similar to the ground truth profiles. Our method greatly reduces the usual reliance on domain experts, and the reconstruction is extremely fast both on GPUs and on CPUs. The source code of EddyNet is released on https://github.com/askerlee/EddyNet.