Teaching Machine Learning Model with Simulated Flaws

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Previous research has proven the plausibility of using modern very deep convolutional neural network to detect flaws from phased-array ultrasonic data. This gives the possibility to utilize the repeatability and effectiveness of computers to complex ultrasonic signal evaluation, previously done exclusively by human inspectors. The major breakthrough was to use virtual flaws to generate ample flaw data for the teaching of the algorithm. This gave the possibility to use ultrasonic scan images for detection and to use the similar approaches as for traditional image recognition used in machine learning. Unlike traditional image recognition, ample training data for ultrasonic inspection is scarce. While virtual flaws give the possibility to broaden the data considerably, original flaws are still required. The same shortage of flaws exists when training human inspectors, this is compensated by using flaws like EDM-notches in place of real flaws. Despite the obvious difference of the flaw types, human inspectors are fully capable of using their intuition and expert judgement to extrapolate this training experience to finding real flaws in the field. Therefore, it is plausible to train machine learning model with similar flaws manufactured cost efficiently and predictably. In this paper we study the possibility of using just simulated flaws to teach a machine learning model to find real thermal fatigue flaws. We simulate a group of flaws and extend their size range through virtual flaws. The trained model is validated with real thermal fatigue flaws and the reliability compared to a model trained with just thermal fatigue flaws.