Nondestructive Evaluation of Tensile Properties of Metal Alloys using Machine Learning

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Metal alloy materials used in various industries may change their tensile properties due to instability of composition or heat treatment during the manufacturing process, so monitoring of the tensile properties is necessary in terms of quality control. Destructive tests such as tensile tests are currently performed for this purpose; however, only sample inspection is possible in these tests, and they require a significant amount of time and expense. In this study, a technique to estimate tensile properties such as yield strength or tensile strength is developed using machine learning and nondestructive testing data, enabling total inspection and real-time selective removal of inferior parts. An ultrasonic nonlinear parameter and eddy-current electrical conductivity, which are known to be correlated with tensile properties, are used as nondestructive test data, whereas a regression model of a Single Neural Network(SNN) and Support Vector Machine(SVM) is used for machine learning. As a result, the SNN model predicted the yield strength and the tensile strength with difference less than 10% compared to the mean of the destructive tensile test results. The developed technique is an innovative method of evaluating destructive tensile properties using only nondestructive testing data and a leading technology that combines nondestructive testing and machine learning. This work was supported by the National Research Foundation of Korea funded by the Korea government (MSIT), 2021M2E6A1084690