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Analysis of damage control of thin plate with piezoelectric actuators using finite element and machine learning approach

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Abstract
In recent studies, piezoelectric actuators have been recognized as a practical and effective material for repairing cracks in thin-walled structures, such as plates that are adhesively bonded with piezoelectric patches due to their electromechanical effects. In this study, we used the finite element method through the ANSYS commercial code to determine the stress intensity factor (SIF) at the crack tip of a cracked plate bonded with a piezoelectric actuator under a plane stress model. By running various simulations, we were able to examine the impact of different aspects that affect this component, such as the size and characteristics of the plate, actuator, and adhesive bond. To optimize performance, we utilized machine learning algorithms to examine how these characteristics affect the repair process. This study represents the first-time machine learning has been used to examine bonded PZT actuators in damaged structures, and we found that it had a significant impact on the current problem. As a result, we were able to determine which of these parameters were most helpful in achieving our goal and which ones should be adjusted to improve the actuator's quality and reduce significant time and costs.

Author Keywords
Damaged structure; Finite element method; Machine learning; Piezoelectric actuators

Index Keywords
Adhesives, Crack tips, Learning algorithms, Machine learning, Piezoelectric actuators, Piezoelectricity, Plates (structural components), Repair, Thin walled structures; Adhesively bonded, Damage control, Damaged structures, Effective materials, Machine learning approaches, Machine-learning, Piezoelectric patch, Practical materials, Thin plate, Thin-walled structures; Finite element method

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