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Improving the performance of damage repair in thin-walled structures with analytical data and machine learning algorithms

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Abstract
In the last four decades, bonded composite repair has proven to be an effective method for addressing crack damage propagation. On the other hand, machine learning (ML) has made it possible to employ a variety of approaches for mechanical and aerospace problems and such significant approach is the repair mechanism and hence ML algorithms used to enhance in the present work. The current work investigates the effect of the single-sided composite patch bonded on a thin plate under plane stress conditions. An analytical model was formulated for a single-sided composite patch repair using linear elastic fracture mechanics and Rose's analytical modelling. From the analytical model, the stress intensity factors (SIF) were calculated by varying all possible parameters of the model. Next, ML algorithms were selected, and comparative studies were conducted for the best possible performance and to identify the parametric effects on optimum SIF. Also, the analytical model is validated with existing work, and it shows good agreement with less than 10% error. This study is particularly important for designing the single-sided composite patch repair method based on analytical modelling. Also, it is important to compare ML algorithms with analytical solutions in regression applications.

Author Keywords
Analytical model; Bonded composite repair; Cracks; Machine learning; Reinforced patch

Index Keywords
Analytical models, Ductile fracture, Fracture mechanics, Learning algorithms, Machine learning, Thin walled structures; Analytical data, Bonded composite repairs, Composite patch repairs, Damage repair, Machine learning algorithms, Machine-learning, Performance, Reinforced patch, Stress-intensity factors, Thin-walled structures; Cracks

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