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Numerical Simulation of Pulse Laser-Generated Ultrasonic Wave and Amplitude Peak Count for Defect Detection

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[Wahab, Nazirah Ab](#)^a ; [Andan, Amelda Dianne](#)^b ; [Yusof, Nurhalawa Md](#)^c ; [Sony, Chindada](#)^d

^a Faculty of Civil Engineering, Universiti Teknologi MARA, Selangor, Shah Alam, 40450, Malaysia

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Abstract

High spatial resolution and the possibility for distant and noncontact measurements have led to substantial research into laser ultrasonic techniques. Pulse lasers produce heat when the surface of a target object absorbs its electromagnetic energy. When a material undergoes a temperature shift, it generates stress and strain fields, which in turn cause an elastic wave known as ultrasound. This research simulated the effects of an ultrasonic wave produced by a laser striking an aluminium plate. Using extremely fine meshes, the pulse laser stimulation is modelled as a localised heat flux imposed to the structure's surface. The 2D simulation data for intact specimen is collected and then compared to an existing experimental data using contactless laser ultrasonic measuring equipment. The model is then subjected to surface damage and identified using a threshold to retrieve the peak count from the laser ultrasonic data while analysing the correlation between damage effects found in various locations and peak counts. The total number of peak counts is measured, and the damage

is successfully detected. Based on the identified peak counts, different damage locations can be determined and analysed. © 2026, National University of Malaysia. All rights reserved.

Author keywords

damage localization; finite element method; Laser ultrasonics; peak count

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Corresponding authors

Corresponding author	N.A. Wahab
Affiliation	Faculty of Civil Engineering, Universiti Teknologi MARA, Selangor, Shah Alam, 40450, Malaysia
Email address	nazirahwahab@uitm.edu.my

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Abstract

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