# An analytical model and parametric analysis of ultrasound-excited infrared thermography

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**Abatract**

Ultrasound-excited vibrothermography (VT) is a newly developed version of IR thermographic NDT, but the relation between the defect signal and mechanical parameters is fuzzy due to the complexity of thermo-mechanical coupling and the interaction effects of multiple factors, so the design of operation conditions of VT mainly depends upon experiences up to now. In order to reveal the relations of the defect signal versus the mechanical parameters, and to enable the optimization of operation conditions, a mathematical model was presented to simulate the heat generation and heat transfer that occur during VT. The heat power produced in a crack and the temperature increase at the crack area were solved by an analytical approach. The function of the temperature increase at the crack area versus the mechanics parameters including the damp, mass, stiffness, amplitude and frequency of the stimulation force, friction coefficient and normal force in crack faces, excitation duration, etc., was deduced. The influences of mechanical parameters on the temperature increase were theoretically analyzed. The crack signature on an aluminum sample was imaged by an IR camera and compared with the theoretical predictions. The influences of experimental factors including the support condition, excitation frequency, duration and power, etc., on the crack signature were partially compared. The results show that the theoretical predictions are in agreement with the observed responses, and the influences of various mechanics parameters on VT can be quantitatively described by the analytical model presented.

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