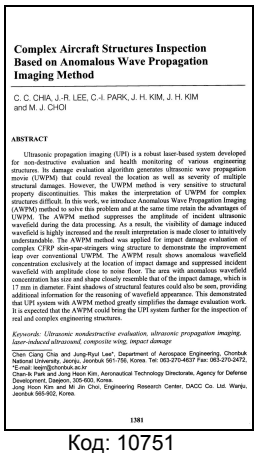

Complex Aircraft Structures Inspection Based on Anomalous Wave Propagation Imaging Method

C. C. CHIA, J.-R. LEE, C.-I. PARK, J. H. KIM, J. H. KIM and M. J. CHOI

ABSTRACT

Ultrasonic propagation imaging (UPI) is a robust laser-based system developed for non-destructive evaluation and health monitoring of various engineering structures. Its damage evaluation algorithm generates ultrasonic wave propagation movie (UWPM) that could reveal the location as well as severity of multiple structural damages. However, the UWPM method is very sensitive to structural property discontinuities. This makes the interpretation of UWPM for complex structures difficult. In this work, we introduce Anomalous Wave Propagation Imaging (AWPM) method to solve this problem and at the same time retain the advantages of UWPM. The AWPM method suppresses the amplitude of incident ultrasonic wavefield during the data processing. As a result, the visibility of damage induced wavefield is highly increased and the result interpretation is made closer to intuitively understandable. The AWPM method was applied for impact damage evaluation of complex CFRP skin-spar-stringers wing structure to demonstrate the improvement leap over conventional UWPM. The AWPM result shows anomalous wavefield concentration exclusively at the location of impact damage and suppressed incident wavefield with amplitude close to noise floor. The area with anomalous wavefield concentration has size and shape closely resemble that of the impact damage, which is 17 mm in diameter. Faint shadows of structural features could also be seen, providing additional information for the reasoning of wavefield appearance. This demonstrated that UPI system with AWPM method greatly simplifies the damage evaluation work. It is expected that the AWPM could bring the UPI system further for the inspection of real and complex engineering structures.

Keywords: Ultrasonic nondestructive evaluation, ultrasonic propagation imaging, laser-induced ultrasound, composite wing, impact damage

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Содержание.