J Nondestruct Eval (2010) 29: 169–174
DOI 10.1007/s10921-010-0074-4

Automatic Crack Detection and Characterization During Ultrasonic Inspection

Thouraya Merazi Meksen[1] · Bachir Boudraa[1] · Redouane Drai[2] · Malika Boudraa[1]

1. University of Science and Technology H. Boumedienne, BP 32, El Alia, 16111 Bab Ezzouar, Algiers, Algeria
2. Center of Welding and Control, Route de Dely Brahim, Cheraga, Algiers, Algeria

Abstract The creation of a non-destructive technique that enables the automatic detection of defects is desirable, and TOFD (Time-Of-Flight Diffraction) technique is gaining rapid prominence due to its high accuracy in detecting, positioning and sizing flaws in steel structures. In this type of imaging, cracks are characterized using sets of hyperbolas, where summit positions correspond to crack tip positions.
However, ultrasonic diffracted signals are often too low and difficult to distinguish from noise, and when large structures are inspected, the quantity of data can be extremely large, with the area of interest being very small in comparison to the image size. This paper describes a method that avoids the image formation, replacing it with a sparse matrix (as there is no reason to store and operate on an excessive number of zeros), and automates crack detection by analyzing the curve formed by the sparse matrix elements.
The sparse matrix is formed using Split-Spectrum Processing, which enhances the signal-to-noise ratio. The Randomized Hough transform is then applied on the sparse matrix elements to detect the hyperbolas that characterize the crack defects.

Keywords Automated inspection · Ultrasonic imagery · Sparse matrix · Defect characterization