عنوان مقاله:

Tomographic reconstruction of isotropic materials using genetic algorithms with ultrasound time-of-flight projection data

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خلاصه مقاله:

Engineering materials and structures have crack-like defects leading to premature failures. The usage of fracture mechanics to assess the structural integrity requires knowledge on the type, location, shape, size, and orientation of the flaws. Tomographic reconstruction is one of the commonly used nondestructive testing methods for flaw characterization. The cross sectional image of the object being tested is obtained through the application of various reconstruction methods that are categorized as either analytical methods or iterative methods. In this work, an iterative algorithm that works on the principles of genetic algorithms is developed and used for the reconstruction. The results of simulation studies on the tomographic reconstructions using genetic algorithms for the identification of defects in isotropic materials are discussed in the paper. The solution methodology based on the use of genetic algorithms is applied to reconstruct the cross sections of test specimens with different flaw characteristics. Simulated time-of-flight data of ultrasound rays transmitted through the specimen under investigation is used as input to the algorithm. The time-of-flight data is simulated neglecting the bending of ultrasound rays and assuming straight ray paths. Numerical studies performed on several specimens with flaws of known materials but unknown location, size and shape are presented. The number of ultrasonic transmitters and receivers needed for complete scanning of the specimen's cross section is analyzed and presented. The findings of the parametric analysis and sensitivity analysis in order to choose appropriate range of algorithm parameters for performance quality and robustness of the algorithm are presented. The performance of the present algorithm with noisy projection data is also discussed.

کلمات کلیدی:

Non-destructive evaluation, Tomography, Tomographic Reconstruction Methods, Genetic algorithms, Ultrasound Time of flight