

Ultrasonic Nondestructive Signals Processing Based on Matching Pursuit with Gabor Dictionary

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Abstract: The success of ultrasonic nondestructive testing technology depends not only on the generation and measurement of the desired waveform, but also on the signal processing of the measured waves. The traditional time-domain methods have been partly successful in identifying small cracks, but not so successful in estimating crack size, especially in strong backscattering noise. Sparse signal representation can provide sparse information that represents the signal time-frequency signature, which can also be used in processing ultrasonic nondestructive signals. A novel ultrasonic nondestructive signal processing algorithm based on signal sparse representation is proposed. In order to suppress noise, matching pursuit algorithm with Gabor dictionary is selected as the signal decomposition method. Precise echoes information, such as crack location and size, can be estimated by quantitative analysis with Gabor atom. To verify the performance, the proposed algorithm is applied to computer simulation signal and experimental ultrasonic signals which represent multiple backscattered echoes from a thin metal plate with artificial holes. The results show that this algorithm not only has an excellent performance even when dealing with signals in the presence of strong noise, but also is successful in estimating crack location and size. Moreover, the algorithm can be applied to data compression of ultrasonic nondestructive signal.

Key words: ultrasonic signal processing, sparse representation, matching pursuit, Gabor dictionary

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