

Ultrasonic Flaw Detection in Composite Materials Using SSP-MPSD Algorithm

Abdessalem BENAMMAR, Redouane DRAI

Abstract: Due to the inherent inhomogeneous and anisotropy nature of the composite materials, the detection of internal defects in these materials with non-destructive techniques is an important requirement both for quality checks during the production phase and in service inspection during maintenance operations. The estimation of the time-of-arrival (TOA) and/or time-of-flight (TOF) of the ultrasonic echoes is essential in ultrasonic non-destructive testing (NDT). In this paper, we used split-spectrum processing (SSP) combined with matching pursuit signal decomposition (MPSD) to develop a dedicated ultrasonic detection system. SSP algorithm is used for Signal-to-Noise Ratio (SNR) enhancement, and the MPSD algorithm is used to decompose backscattered signals into a linear expansion of chirplet echoes and estimate the chirplet parameters. Therefore, the combination of SSP and MPSD (SSP-MPSD) presents a powerful technique for ultrasonic NDT. The SSP algorithm is achieved by using Gaussian band pass filters. Then, MPSD algorithm uses the Maximum Likelihood Estimation. The good performance of the proposed method is experimentally verified using ultrasonic traces acquired from three specimens of carbon fibre reinforced polymer multi-layered composite materials (CFRP).

Keywords : Non-Destructive testing, Ultrasonics, Carbon fibre, Defects, Signal processing