Application of all-optical and non-destructive laser ultrasonic in imaging of CFRP subsurface defects

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Subsurface defects such as delamination and disbond, could severely affect the performances of composite materials and need to be evaluated in time. In this work, a variety of artificial subsurface defects in carbon fiber reinforced polymer (CFRP) composites was characterized using an all-optical and nondestructive laser ultrasonic (LU) technique with an optical microphone. Rigrsure thresholding selection role was selected and convinced to effectively denoise the LU signals using the wavelet transform denoising method. Four kinds of featured C-scan images of the artificial defects were proposed to determine the size of artificial flaw regions and compared each other. A model for determination of the depth of flat-bottom holes in CFRP composites was proposed and simultaneously confirmed with experiments. This investigation has carried out successful applications of the all-optical and nondestructive LU technique for quantitative imaging of subsurface defects in CFRP composites with advantages of non-contact, and quantitive determination of the size and depth of flat bottom holes.

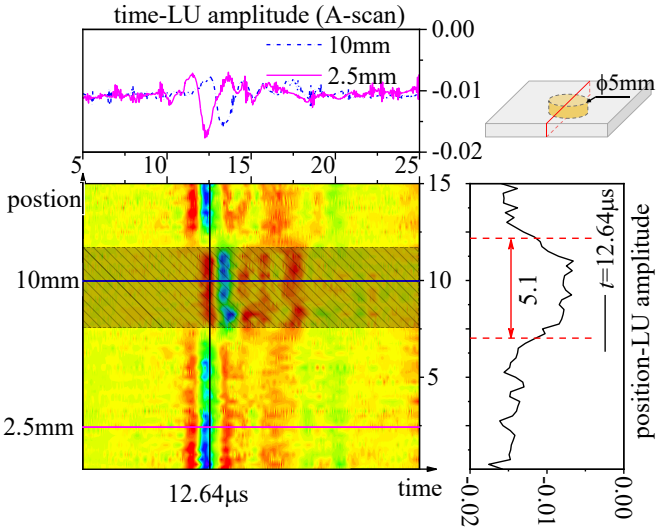

Fig. 1. Time-domain LU results along the diameter scanning and corresponding position profiles as well as A-scan profiles for ϕ5 mm flat-bottom hole in No. 1 specimen.

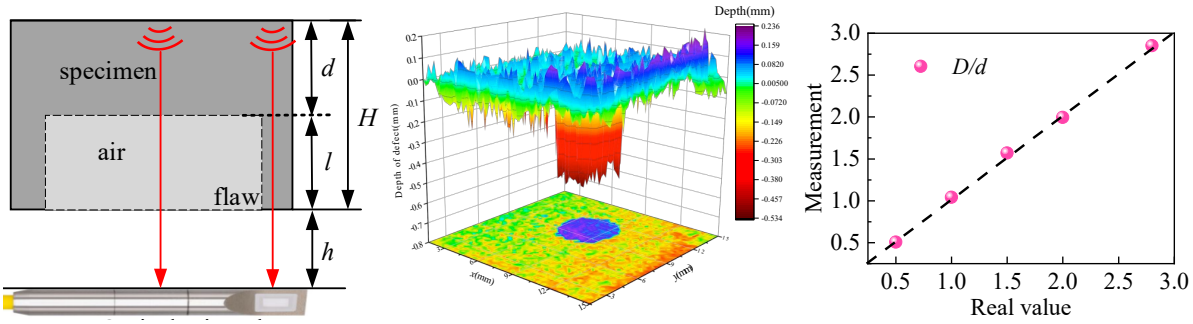

Fig. 2. (a) A diagraph for calculation of the flat-bottom hole using an optical microphone, **(b)** the calculated depth distribution of #3 flat bottom hole (*D*=5 mm, *d*=2.5 mm) in No. 1 specimen, **(c)** comparison of the measurement value with the real value at various diameter to depth ratio of flat-bottom holes

References

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