The feature detection of GFRP subsurface defects using fast randomized sparse principal component thermography

Shen P[(1)†], Luo Z[(1)†], Wang S[(1)], Mao F[(1)], Su Z[(1)], Zhang H[(1)*]

(1) Jiangsu Key Laboratory for Design and Manufacture of Micro-Nano Biomedical Instruments, School of Mechanical Engineering, Southeast University, Nanjing 211189, China

†Peng Shen and Zhi-Tao Luo contributed equally to this work.

*Corresponding author's email: seuzhanghui@seu.edu.cn

Machine learning methods play an increasingly important role in the nondestructive testing and evaluation of composites. As a popular feature extraction and dimension reduction method of thermographic data, principal component thermography is often used. However, the interpretability of its PCs and its ability to handle large-scale thermographic data affect the applicability of PCT for high-resolution thermographic NDT. In this paper, a fast randomized sparse principal component thermography (FRSPCT) is used to detect the subsurface defects of glass fiber reinforced polymer (GFRP) composites. The effectiveness of the method is demonstrated by the large-scale thermographic data of GFRP with subsurface defects. The comparison results show that the FRSPCT method gives the overall highest signal-to-noise ratio (SNR), detection rate (DR), and satisfactory runtime. In addition, the method can also provide more easily interpretable defect detection results and highlight the hidden details of irregularly-shaped abnormal defects.