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# HYPERVELOCITY IMPACT DAMAGE PATTERN RECOGNITION IN ALUMINUM ALLOY PLATES BASED ON D-S EVIDENCE THEORY AND BP NEURAL NETWORK

**Abstract**

Damage pattern recognition is a significant function module of on-orbit monitoring system for space debris hypervelocity impact (HVI) on spacecrafts. However, the damage recognition results based on a single sensor may be unreliable and unstable due to the noise interference and the interruption of HVI acoustic emission (AE) signal propagation by structural features such as holes and thickness changes. So that multi-sensor information fusion was necessary to gather multi-channel AE signals, extract their respective feature, and finally produce the damage recognition results. Hypervelocity impact experiments were performed, during which the AE signals induced by the damage of the aluminum alloy plates were obtained using ultrasonic transducers. Combined with the accurate source location method for virtual wave front, time-frequency analysis, wavelet decomposition and Kruskal-Wallis testing, this work extracted and optimized the relevant parameters of the damage pattern from the hypervelocity impact AE signals, thereby developing a method of multi-sensor information fusion for damage pattern recognition, which combined D-S evidence theory and BP neural network. The results show that using the method can successfully recognize the crater and perforation damage patterns in aluminum alloy plates, obtaining the depth of crater and the diameter of hole. Moreover, the method not only improves the identification accuracy and fault-tolerant ability but also has good adaptive capacity. Even some sensors failure or degradation, it is still possible to make effectively identification on the structural damage. Finally, the conclusion of this paper will have important reference value for developing on-orbit monitoring system of future space station.