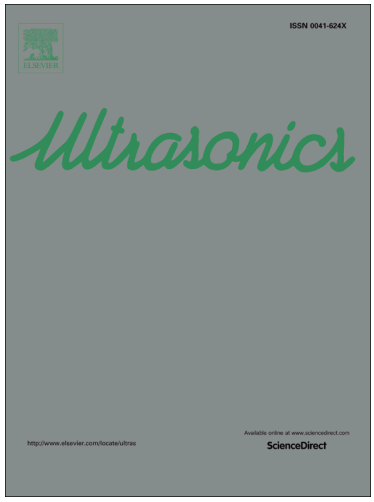

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Feasibility study of ultrasonic elliptical vibration-assisted reaming of carbon fiber reinforced plastics/titanium alloy stacks

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ABSTRACT

The production of high quality bolt holes, especially on the carbon fiber reinforced plastics/titanium alloy (CFRP/Ti) stacks, is essential to the manufacturing process in order to facilitate part assembly and improve the component mechanical integrity in aerospace industry. Reaming is widely used as a mandatory operation for bolt holes to meet the strict industry requirements. In this paper, the ultrasonic elliptical vibration-assisted reaming (UEVR) which is considered as a new method for finish machining of CFRP/Ti stacked holes is studied. The paper outlines an analysis of tool performance and hole quality in UEVR compared with that in conventional reaming (CR). Experimental results show that the quality of holes was significantly improved in UEVR. This is substantiated by monitoring cutting force, hole geometric precision and surface finish. The average thrust forces and torque in UEVR were decreased over 30% and 60% respectively. It is found that, during first 45 holes, better diameter tolerance (IT7 vs. IT8), smaller diameter difference of CFRP and Ti holes (around 3 μm vs. 12 μm), better geometrical errors were achieved in UEVR as compared to CR. As for surface finish, both of the average roughness and hole surface topography in UEVR were obviously improved.

Key words: CFRP/Ti stacks; Reaming; Cutting force; Surface finish

1. Introduction

Nowadays, the CFRP and metal alloy stacked multilateral structures, especially the CFRP/Ti stacks, are widely used for the wing segments and fuselage of an aircraft due to their high strength to weight ratio, and excellent corrosion and heat resistance [1]. A lot of benefits

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