ABSTRACT

Ultrasonic Vibrated Assisted Turning (UVAT) techniques have become a modern industrial manufacturing method for cutting materials. This method uses ultrasonic waves to create relative movement between the cutting tool and the workpiece, producing cuts or cuts with a high level of accuracy and precision. This study focuses on increasing the efficiency and quality of UVAT machining by studying the use of asymmetric notch hinges as vibrating tools used during the feeding process. Vibrations in UVAT machining are generated through the use of piezoelectric ceramics which produce vibrations with certain frequencies. However, to achieve optimal vibration, a vibration tool design is needed that can increase the level of deformation produced by the piezo. This research began by designing and simulating an asymmetric notch hinge on a vibration tool using simulation software based on the finite element method. This simulation was carried out to understand the response and characteristics of asymmetric notch hinges with parameters (radius, hinge thickness, and distance between hinges) in transmitting vibrations to maximize deformation and reduce hinge stress. The influence of each design parameter will be evaluated through a planned study using the full factorial method with a design of experiment (DOE). Thicker hinges can reduce stress and reduce deformation. Meanwhile, a larger radius can increase stress and increase deformation. However, changing the size of the distance between hinges cannot measure the effect on deformation and stress because there are variables that change when the radius size is changed. The optimal design was determined using the gray relational analysis method with optimal results, namely 1 mm radius, 6.5 mm hinge thickness, and 7 mm distance between hinges. This design can maximize tool deformation up to 8.56 μm and minimize the stress received by 216.91 MPa. Thus, the results of this research are expected to contribute to developing optimal designs that can increase the level of deformation in UVAT machining.

Key word: UVAT, Flexure Hinge, Notch Hinge, Deformation, Design Parameter, Finite Element