ABSTRACT

Ultrasonic Vibration-Assisted Turning (UVAT) has shown a trend of incorporating flexure hinges as connectors for transmitting vibrations from piezoelectric actuators to vibration tools. The polynomial hinge is a hinge characterized by its design, which follows a polynomial order, thereby offering greater flexibility for designers. This is due to the polynomial hinge's ability to encompass the characteristics of other hinge types. This study aims to analyze the effects of polynomial hinge design parameters using the finite element analysis (FEA) method. The simulation assesses the impact of design parameters such as polynomial order, hinge thickness, and hinge length on tool tip deformation and the resulting stress. The design parameters were combined using a full factorial method with five levels for each parameter. Increasing the polynomial order and hinge length resulted in a twofold increase in deformation, from 0.9 µm to 2.04 µm, and an increase in stress, from 61 MPa to 112 MPa. In this study, Grey Relational Analysis was used to identify the optimal polynomial hinge design combination, with a polynomial order nnn of 2, hinge thickness of 4 mm, and hinge length of 6 mm. This combination resulted in a deformation of 1.47 µm and a stress of 39.1 MPa. Therefore, this study is expected to contribute to the knowledge of polynomial hinge design in ultrasonic vibration-assisted machining, enabling its application in various industries.

Kata kunci: Ultrasonic vibration-assisted machining, *Flexure hinge*, *Polynomial Hinge*, Deformation, Finite element analysis