3D micromechanical modeling of orthogonal hole saw cutting on CFRP composites	
Authors	**Amira Hassouna, Slah Mzali, Salah Mezlini, Nashmi H Alrasheedi, Khalil Hajlaoui**
Publication Year	2024
Grant Number	IMSIU-RP23029
DOI link	10.1177/0892705724122903

Abstract: In the interest of developing a comprehensive understanding of the drilling process using the hole saw tool, this article aims to build a three-dimensional (3D) micromechanical model representing the orthogonal cutting of CFRP using one tooth of the hole saw tool. For this purpose, a finite element model is developed using Abaqus Explicit code. The influence of various drilling parameters like rake angle, inclination angle and cutting-edge radius on the drilling quality is explored. Especially, chip formation mechanisms, cutting force and lateral damage are analyzed. Through finite element simulations and computational analyses, it is found that these outputs results are highly influenced by drilling parameters. When the fiber orientation angle is set to 0°, increasing the rake angle results in a change in the chip formation mechanism from buckling to bending. In contrast, with a fiber orientation angle of 90°, bending and shear governs the chip formation process, irrespective of the rake angle. In both cases, whether the fiber orientation angle is 0° or 90°, chips tend to fragment more favorably with increasing the inclination angle. Regarding the cutting-edge radius, when the fiber orientation angle is 0°, an increase in the cutting-edge radius leads to a transition in the chip-forming mechanism from buckling to bending. However, for a fiber orientation angle of 90°, the chip formation remains governed by bending even as the cutting-edge radius changes. Decreasing the rake angle, the inclination angle, and the cutting-edge radius contribute to a reduction of the cutting force. As the inclination angle and the cutting-edge radius increase, the lateral damage increases, while the rake angle has showed a negligible impact on the damage. These results provide a guidance on the appropriate hole saw tool parameters for a good drilling quality namely, a rake angle of 20°, an inclination angle of 5° and a cutting-edge radius of 0.03 mm.