**THE EFFECT OF INFILL PATTERNS ON 3D PRINTED PLA PARTS FOR MICRO AND MACRO PROPERTIES USING HOMOGENIZATION METHOD**

Aisyah Allias1, Khairul Salleh Basaruddin1\*, Nor Amalina Muhayudin1, Shah Fenner Khan Mohamad Khan1, Tien-Dat Hoang2

1Faculty of Mechanical Engineering & Technology, Universiti Malaysia Perlis, 026000 Arau, Perlis, Malaysia.

2School of Mechanical and Automotive Engineering, Ha Noi University of Industry, Hanoi, Vietnam.

**Abstract**

This study employed the homogenization method in VOXELCON to examine how the infill patterns affect the micro and macro properties of 3D printed parts. Polylactic acid (PLA) is a material that is widely used in 3D printing technologies across different industries. Nevertheless, only a few research has been done on how infill patterns affect the micro and macro characteristics of 3D printed PLA, despite its widespread used. Because of factors including material utilization, infill density, and mechanical behaviour, choosing the best infill pattern can be difficult. Multiple 3D printed PLA sample pieces are needed to conduct reliable analysis, however the procedure takes time and can cause major delays. To solve this, finite element analysis (FEA) is used to reduces the need for actual 3D printed parts while also saving time and procedure. With this technique, different design can efficiently be examined without the requirement for actual prototyping. Investigating the effect of these infill patterns on the micro-properties of the PLA models, and analyze how the influence of infill patterns in the micro model impacted the macro-properties of the 3D printed PLA parts are the goal of this study. Homogenization method is used to analyse the micro model. With the result from the method, the micro model data from the homogenized material properties are imported as material properties for the macro model, and the constraint and pressure of the macro model is assigned. For the result, the octet design displays the lowest von Mises stress at 48 MPa, showing superior stress distribution, while the gyroid pattern displays the maximum stress at 56 MPa. The gyroid pattern (850 MPa), the octet pattern (400 MPa), and the line pattern (430 MPa) have the highest stiffness in the E11 direction, E22 direction, and E33 direction, respectively, according to the stiffness analysis. Shear moduli and Poisson's ratios for various infill patterns are also examined in the paper, with notable differences found. Because of their balanced stiffness and stress distribution, octet patterns display superior mechanical performance over the concentric pattern, which is characterized by low stiffness and high stress. The study emphasizes how porosity and infill pattern design affect von Mises stress, which helps choose the right patterns for certain mechanical needs. Further research should investigate materials and patterns more broadly, improve computational precision, and take dynamic load circumstances into account.