ABSTRACT

The contour-parallel strategy is a common approach in 2D pocket milling, but it can result in inefficient toolpaths due to non-productive movements such as retracts and repositioning, especially in complex pocket geometries like Modular Curved-Island. This study proposes the PRT-GCAM method (Point Reduction and TSP using G-code from CAM) as a solution to optimize the cutting path. The method begins by extracting toolpath coordinates from CAM-generated G-code, followed by point simplification using a combination of Distance-Based Point Reduction and the Ramer–Douglas–Peucker (RDP) algorithm to reduce point data noise. Next, the Lin-Kernighan Helsgaun (LKH) algorithm is applied to optimize the point sequence based on the Traveling Salesman Problem (TSP) approach. Evaluation was conducted through simulations and actual machining on Aluminium 6061 material. The results show that the PRT-GCAM method can reduce machining time by more than 60% and significantly decrease the number of retracts compared to conventional contour-parallel strategies. These findings demonstrate that PRT-GCAM is an effective approach that can be integrated into CAM-based manufacturing processes to improve toolpath efficiency in 2D pocket milling.

Keywords: 2D pocket milling, toolpath optimization, G-code, TSP, Lin-Kernighan Helsgaun, point reduction, CNC, PRT-GCAM.