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Highlights

- Parameter optimization method for tool-path planning is provided.
- Tool-path planning with constraint of cutting force fluctuation is proposed.
- Cutting towards small normal vector change direction reduces force fluctuation.
- Reduction of cutting force fluctuation will improve machining quality directly.

Abstract

Curved surface parts are widely used in the industrial applications and the three-axis NC machining with ball-end cutter is the commonly adopted method for certain curved surface parts machining due to its high stiffness and simple operation. With the usage of this approach, the cutting area for different machining positions of the curved surface is changing all the time which results in a severe cutting force fluctuation among the machining process and the cutting force fluctuation is one of the vital factors that affect the machining quality of curved surface parts and the tool life. For the tool-path becomes the main factor that influences the cutting force fluctuation under the condition that the processing condition is determined, an appropriate tool-path planning method with the constraint of cutting force fluctuation for the curved surface machining is crucial for not only guaranteeing machining quality but also prolonging tool life. Based on the cutter location points obtained by the constant scallop-height method, cutting path interval and cutting step length are optimized and the cutter location mesh units are divided firstly, so as to meet the geometry accuracy for the curved