実切取り厚さの切削力による推定に基づいたエンドミル加工の加工面形状シミュレータ

Machined surface simulator for end milling based on cut thickness estimation by cutting force.

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金属加工において加工面形状の推定は製品の品質確保のために重要性が高い．しかし，加工において工具の振れ回りや被削材の振動など様々な要因により，加工条件に基づく幾何的なモデルのみを用いて精度よく形状推定を行うのは困難である．そこで本研究では，スクエアエンドミルの切削力から逐次の切取り厚さの推移を求め，加工面形状を推定するモデルを構築した．具体的には，切削モデルと切削領域判定アルゴリズムを組み合わせて時間領域での切削シミュレータを構築した．実際の側面加工における切削力を用いて加工面形状をシミュレーションすると，切れ刃周波数に同期した加工面形状の周期成分を確認できた．また，切削力の振動が切取り厚さに影響を与え，シミュレーション上において極端に切込みが大きくなることがあった．

In metal machining, the estimation of the machined surface shape is highly important to ensure product quality. However, due to various factors such as tool runout and workpiece vibration during machining, it is difficult to accurately estimate the shape using only a geometric model based on machining conditions. Therefore, in this study, a model was constructed to estimate the machined surface shape by determining the sequential transition of cutting thickness based on the cutting force of a square end mill. Specifically, a cutting simulator in the time domain was constructed by combining a cutting model and a cutting area determination algorithm. Simulation of the machined surface shape using the cutting force in actual side machining showed a periodic component of the machined surface shape synchronized with the cutting edge frequency. The cutting force oscillation affected the cutting thickness, resulting in extremely large depth of cut in the simulation.

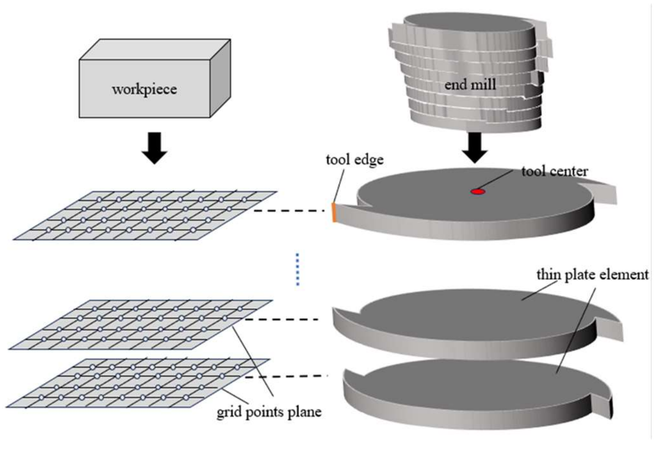

Fig. 1. Split of workpiece and endmill

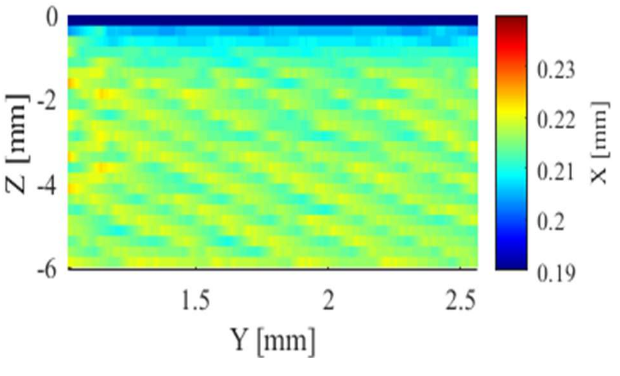

Fig. 2. Simulated machined surface by cut thickness calculated with ideal cutting force.