研 究 論 文 抄 録

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エレクトロメカニクス学科

笠原和夫・広田明彦・赤間　知：「斜面のボールエンドミル加工の切削抵抗と切削機構の解析（第 1 報）－切削過程の幾何学量と切削模型および予備的検討－」, 精密工学会誌, 74 巻, 9 号，pp.965-970，2008.9

In order to predict cutting forces and chip formation in milling with a ball end mill for various tool paths, inclination of the workpiece surface and of the tool axis, a cutting model proposed in previous paper is extended to the milling process in which both cutting edges of the sphere and cylindrical portions engage with the workpiece. In the cutting model, elemental chip at any point on the cutting edge is described by simple shear plane oblique cutting model, and the condition of side-curl of the chip is considered. In this paper, cutting edge configurations, inclination and normal rake angles at the sphere and cylindrical portions are discussed. Geometric quantities such as contact region between the cutting edge and the workpiece surface, and undeformed chip thickness along the cutting edge in milling for the tool moving upward or downward on the inclined surface are analyzed, and variation of these geometric quantities with tool rotational angle are also discussed. Three components of the cutting force and chip formation such as chip flow angle, radius of side-curl of the chip and chip form are predicted by using developed cutting model and energy method. The preliminary examination shows that there is the large difference in cutting forces and the chip formation for the tool moving upward or downward on the inclined surface.

笠原和夫・広田明彦・赤間　知：「斜面のボールエンドミル加工の切削抵抗と切削機構の解析（第２報）－工具が上昇および下降する切削過程の計算結果と実験結果との比較検討－」, 精密工学会誌，74 巻，10 号，pp.1068-1073，2008.10

In the 1st part of this investigation, a cutting model taking account of the condition of side-curl of the chip proposed in previous paper has been extended to milling process in which both cutting edges of the sphere and cylindrical portions engage with the workpiece. Geometric quantities such as contact region between the cutting edge and the workpiece surface, undeformed chip thickness along the cutting edge and area of cutting cross-section in upward or downward milling of inclined surface has been analyzed. In this paper, the cutting forces and chip formation in above upward or downward milling for various inclined surfaces are predicted by using the cutting model and energy method. Three components of the cutting force are measured by a piezo-electric type dynamometer and compared with those obtained through theoretical prediction. The predicted results are good agreement with the experimental results. From the comparison of chip form described by using the predicted value of chip flow angle and radius of side-curl of the chip and chip form obtained experimentally for various inclined surfaces, it is shown that transition of the chip form with inclination angle of the workpiece surface can be analytically obtained.