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微纳技术与精密机械

连续多点成形中的成形载荷分析

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摘要： 研制了连续多点成形装置来完成三维曲面工件的高效、柔性加工,并对其成形载荷的变化趋势以及不同工艺参数对成形载荷的影响进行了研究。首先,介绍了连续多点成形原理;基于一定的假设条件,建立了成形载荷的理论公式;以双曲率元件为研究对象,建立有限元模型,分析了*y*方向载荷、*z*方向载荷以及合成载荷的变化情况。接着,分析了上辊压下量、板材厚度以及柔性辊曲率半径对成形载荷的影响。最后,设计出成形装置并进行实验。结果表明,*y*方向载荷最大值为6.693 kN,成形载荷的最大值为6.716 kN,成形载荷主要由*y*方向载荷决定;*z*方向载荷最大值为1.412 kN,为驱动工件运动的力;随上辊压下量的增加、板材厚度的增加以及柔性辊曲率半径的减小,*y*方向载荷均增加。成形载荷的变化情况与实际情况吻合,为成形装置的研制提供了指导作用。实验结果证明,连续多点成形是一种连续、高效、柔性的三维曲面成形方法。

关键词： 柔性加工 连续成形 多点成形 数值分析 三维曲面

Analysis on forming load in continuous multi-point forming

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Abstract: A Continuous Multi-point Forming (CMPF) equipment was developed to manufacture 3D surface parts in high efficiency and flexibility, and the historical changing of forming loads and the influences of different technical parameters on forming loads were analyzed. First,the principle of CMPF was introduced,and theoretical formulas of forming loads were established based on certain hypothetical conditions. By taking a double curvature part as a research object,a Finite Element Analysis(FEA) model was established, and the historical changings of *y* direction load, *z* direction load and equivalent load were analyzed. Furthermore,the influences of press displacement, thickness, and curvature radius of a flexible roller on forming loads were analyzed. Finally,the equipment was designed, and experiments were carried out. Results indicate that the maximum value of *y* direction load is 6.693 kN, maximum of forming load is 6.716 kN, and the forming load is made up of *y* direction load nearly. Moreover,the maximum value of *z* direction load is 1.412 kN, which is considered as a driving force. Along with the increases of press displacement and thickness of sheet metal, the *y* direction load is increased. Along with the decrease of curvature radius of a flexible roller,the *y* direction load is increased. The changing situations of forming loads accord with practical situation, which offers a guidance for CMPF equipment. From experimental results, CMPF is a continuous, high efficiency and flexible forming method for 3-D surfaces.

Keywords: flexible manufacturing continuous forming multi-point forming numerical analysis 3D surface

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