Uni-edit - Sample of Rewrite

~~The~~ Normal Double-Faced Rapid Prototyping Process ~~by~~ using Slope Layer Compensation

Comment [WL1]: CHECK:
Because many sentences in this paper were very long, the meaning was sometimes difficult to determine. Please check the sentences I have written express your ideas accurately.

Abstract

Purpose –The study ~~is~~ focuse~~d~~ on the normal ~~Double~~double-~~Faced~~ faced rapid prototyping process. The cutting tool compensation route formula is derived from the different cutting thickness and the change ~~of~~ in slope. ~~and~~ ~~I~~it is then introduced into the cutting layer program in order to obtain a dynamic single-~~-~~layer route compensation.

Design/methodology/approach –Each layer route compensation will be converted into numerical control (NC) code to construct the 3D models.

Findings – The main purpose of this study is to ~~improve~~ reduce the staircase effect. For ~~the~~ currently available rapid prototyping stacking system~~s~~, the surface contour is not exactly a staircase ~~presentation~~configuration. ~~It is believed that if during the manufacturing process, integrated the slope compensation on each layer into the cutting manufacturing process can produce a thicker cutting layer and provide a higher accuracy, which would lead to a more accurate and faster speed result.~~It is believed that if this method ~~were to be~~is introduced into the manufacturing process, it would allow the production of a prototype with a thicker cutting layer while providing similar accuracy to conventional methods. This will lead to faster production of models with higher accuracy.

Originality/value – The cutting rapid prototyping method discussed here ~~indeed~~ produces a 0.55mm layer thickness with ~~the~~ an accuracy ~~which is close~~similar to the accuracy ~~produced~~ of ~~by~~ the V~~v~~iper Si^2 cutting method with the layer thickness of 0.05mm. This demonstrates that ~~with~~ using this method, ~~the surface accuracy and cutting speed can be obtained at one time.~~the surface accuracy can be maintained whilst~~e~~ decreasing the production time.

Keywords: Rapid prototyping~~es~~, Staircase effect, Mid~~dle~~ point compensation, Adaptive slicing

Paper type Research paper

Introduction

Rapid prototyping is a brand new technology, which in the recent years has been widely accepted by the market, while facing the trend of ever seeking changes and improvement, for shortening the time on making of a product, rapid prototyping would exactly meet this kind of requirement, which can quickly produce a prototype product. There are many advantages to rapid prototyping, while it is not necessary to clip support the workpiece, it has the ability to process the workpiece that cannot be done by the conventional processing methods, as well as workpiece with complicated shape and form. Rapid prototyping (RP) is a relatively recent technology that employs techniques that have been established since the late 1980s. Since then, RP has used by companies desiringseeking a decrease in the time required to produce a prototype for evaluation. RP has advantages over conventional processing methods in that it is not necessary to have a support clip on the workpiece, and it can easily produce a workpiece with complex shapes and form. Due to the limitation by the nature of layering process, there are obvious cross-sectional differences between shaped stacked layers. Because of these differences, determined by the thickness of each layer, the surface of the object is not as smoothed, which cannot avoid having the finished object not to occur with staircase effect(P.J. de Jager, J.J. Brock and J.S.M. Vergeest, 1997)(Hong Wenbin, Lee Yong Tsui and Gong Haiqing, 2005). Consequently, this kind of phenomenon is what the user cannot accept for the current rapid prototyping system. Due to the nature of the layering process employed by RP, obvious cross-sectional differences are present between the layers. These differences are determined by the thickness of each layer and results in an unsmooth object surface that resemblesing a staircase, hence the term 'staircase effect' (P.J. de Jager, J.J. Broek and J.S.M. Vergeest, 1997), (Hong Wenbin, Lee Yong Tsui and Gong Haiqing, 2005). This effect is highly undesired by users of current RP systems. For the sake of solving this problem, and to achieve a definite precision on the surface of the processing piece, the most common way is to adopt a more detailed cutting layer, and to use a more delicate cutting layer on improving the staircase phenomenon that happens on thicker cutting layer, in order to reduce the surface error, although by this way, it still cannot truly improve the main time factor that occurs during the staircase phenomenon. The most common solution to this problem is to adopt a thinner cutting layer to prevent the staircase phenomenon that would otherwise occur with a thicker cutting layer. However, this method cannot reduce the additional time required to deal withements caused by the staircase phenomenon.

Currently there are many improvements been made on cutting layers both domestically and abroad, as well as to provide with many methods on the technique, but there aren't too many people that actually have application on rapid prototyping machine, like Bahattin Koc from Industrial Engineering Department of Buffalo University of the United States, which he has proposed the usage on ruled layer(Bahattin Koc, 2004), in his case, he had made improvement on staircase error that occurred by the adaptive slicing technology(K. Tata, G. Fadel, A. Bagchi and Nadim, 1998)(K. Mani, P. Kulkarni, and D. Dutta, 1999), as shown in Figure 1, one can see clearly that the staircase error still occurred from the improvement on the traditional 2D cutting layer, but this method cannot applied directly on the layer stacking processing, which is one of the major defect.Although many studies have been madeconducted regarding improvements on theto the cutting layers and implementation methods both domestically and abroad, not many attempts have been made at actual implementation on a RP machine. However, a proposal was made by B. Koc of the Buffalo University Industrial Engineering Department in the United States to employ a ruled layer (B. Koc, 2004). In this case, an improvement was madein onreducing the staircase effect that occurred from theby use of adaptive slicing technology (K. Tata, G. Fadel, A. Bagchi and Nadim, 1998) (K. Mani, P. Kulkarni, and D. Dutta, 1999). It can be seen in Fig.ure 1 that the staircase effect (Fig. 1b) has been improvedreduced (Fig. 1c) from the traditional 2D cutting layer. However, a major drawback of this method is that it cannot be applied directly to the layer stack processing method.

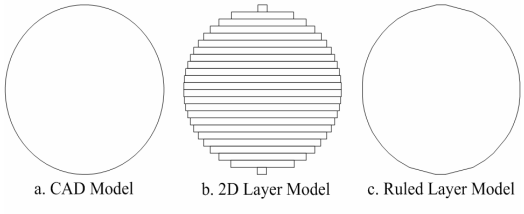

Figure 1 a. Spherical CAD Model **b.** 2D Cutting Layer Model **c.** Ruled Layer Model

Since the rapid shaping system is adapting layer processing method, thickness on the cutting layer will be the most important parameter of processing that will affect on the making speed and accuracy of the technique of Rapid Prototyping. Moreover, to determine the cutting layer thickness will be the most technical task on operating the RP system. Currently, the average RP machines are mostly using a fixed layer thickness constructing method, the size of the error capacity on the gap between the actual curve and the layer thickness is determined by the accuracy of the z-axis direction, in order to obtain a higher precision, there need to have a thinner thickness on the cutting layer, but relatively it will increase on the number of constructing layers, thus, increase on the time of processing; in other words, precision and speed must contradict with each other, how to concurrently giving consideration to both precision and speed, has all along been the key point on the related research. Since the rapid shaping system is an adaptation of the layer processing method, the thickness of the

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Please check that this paragraph properly conveys what you're trying to get across to the reader.

cutting layer ~~will be~~is the most important parameter affecting the prototyping speed and accuracy. Furthermore, ~~the~~ determination of ~~the~~a suitable cutting layer thickness ~~to employ will be~~is the most technical task in the operation of the RP system. Currently, most RP machines employ a fixed layer thickness ~~in their operation~~. The ~~size of the~~ gap error ~~of the gap~~ between the actual curve and the layer thickness is determined by the accuracy in the z-axis direction. In order to obtain a higher precision, a thinner ~~thickness of the~~ cutting layer is required. However, this will also increase the number of constructing layers required, hence increasing~~e~~ the processing time of the RP system. ~~Summarily~~In sum, ~~the~~ precision and speed of the RP system are inversely related and ~~the~~finding ~~key point of related research is to determine~~ a method that ~~idealizes~~optimizes both the precision and speed of the RP system is key.

Methodology

I. Double-faced Processing System

~~Among many literary review of domestic and abroad, all the cutting layer model been mentioned are only on improving CAD model for the cutting layer, which has not directly applied within rapid prototyping system, normally the cutting layer CAD model is shown by staircase model, but actually layer processing model of the rapid prototyping system, is not formed by staircase model, as shown in Figure 2, one can clearly see that the layer processing model for SLA and LOM are all different (Feng Lin Wei Sun, and Yongnian Yan, 2001), relatively speaking, cutting layer CAD model should also adjust into a layer processing model for various types of rapid prototyping system, for this reason to adjust the error on single layer contours, can enable the prototyping to becoming closer to the CAD size under the stack layers processing.~~In most studies, ~~carried out both domestic~~both from Taiwan ~~ally~~ and abroad, ~~the discussions made regarding~~ cutting layer methods are discussed only ~~related~~on relation to the improvement of the CAD model. This is not directly applied within an RP system. The cutting CAD model is normally shown as a staircase model, but in ~~actuality~~practice~~,~~ the layer-~~-~~processing model of the RP system is not formed ~~by this model~~in this way. As shown in Figure 2, ~~one can clearly observe that~~ the layer processing model for the stereolithography –apparatus (SLA) prototypes and laminated object manufacturing (LOM) prototypes are different (Feng Lin Wei Sun and Yongnian Yan, 2001). ~~Relatively speaking, the cutting layer CAD model should also be adjusted for a layer processing model for various types of RP systems. This will allow the control of the error on single layer contours and will enable the prototype to more similar to the CAD model using the stack layers processing method.~~

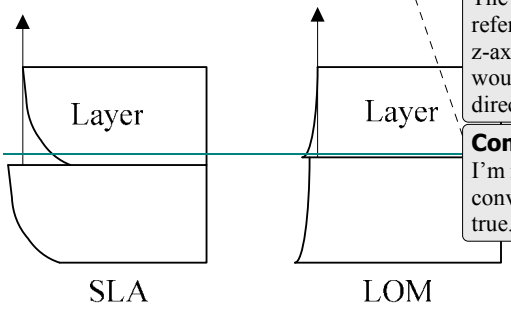

Figure 2 ~~Layer processing model of SLA and LOM~~

~~This research has utilized the average NC processing machine to achieve the concept of stack layers processing of rapid prototyping system, and at the same times to compensate on the error resulted from adjusting the handle on the cutting tool, which is similar to LOM's rapid prototyping system concept, yet the processing method that is employed is the average cutting tool, and not the laser processing, for this principle utilized single layer double faced processing method, and to proceed with stack layers processing principle and to collocate with cutting tools pathway for compensation, which can improve upon the staircase phenomenon of rapid prototyping, and to utilize the least amount of stack layers, in order to achieve on enhancing the degree of exhibition on the curved surface of the prototype with a refined exterior.~~This ~~study utilized a conventional numerical control (NC) processing machine to achieve the concept of stack layers processing of a RP system. At the same time, compensation was also made for the error resulting from the adjustment of the handle on the cutting tool. This is similar to~~

Comment [WL3]: IDEA:
The z-axis can be reoriented, consider referring to another orientation to align the z-axis before using the term. An example would be "…in the upwards or the z-axis direction".

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I'm not sure if this is what you're trying to convey to the readers. Please check that it is true.

Comment [WL5]: TUTOR - sentence structure:
Try breaking your paragraphs into separate shorter sentences to better convey your point to readers.

LOM's RP system concept except for the fact that a conventional cutting tool is employed and not a laser cutting tool. This principle utilized the single layer double faced processing method, then proceeded with the stack layers processing principle collocated with the cutting tools pathway for compensation. This improves the staircase effect while utilizing the least number of stack layers, hence refining the exterior curved surface of a prototype.

The concept of this system is on determining the thickness of the cutting layer, to proceed on calculating the cutting tool path of each layer, in order to compensate the error on the processing formula, the next step will return to the mechanical processing, to use the diameter of the processing cutting tool to calculate the error on the pathway, then to compensate the error of these pathway, then to input into NC formula, and to use the NC formula after compensation, to proceed with sculpturing by the machining device, and according to the sequence of the cutting tool path of each layer to compensate into the NC formula, and to first proceed with front side processing, according to this order, from the bottom to the top, gradually to fill in the raw material in order to combine the workpiece together, after finish with it, the 3-D prototype of the finished product then can be taken out. Also among which we will analyze the processing time and the accuracy on the finished product.The concept of this system is to first determine the thickness of the cutting layer, then to proceed on with calculation of the cutting tool path of each layer. In order to compensate for the error in the processing formula, the next step will return to mechanical processing using the diameter of the cutting tool to calculate the error of the pathway. Compensation is then made for this error and the NC formula is utilized after compensation to proceed with the sculpturing by the machining device according to the sequence of the cutting tool path of each layer. We then proceed to front side processing from the bottom to the top, gradually filling in the raw material in order to produce the workpiece. After completion, the 3D prototype of the finished product can then be taken out. The processing time and the accuracy of the finish product is also evaluated.

As shown in Figure 3, within the course of every processing cycle, there are four main steps, according to its sequence it is input the material, front side processing, reverse side processing, descending on right platform, and to repeat the cycle, until the entire 3D workpiece is finished, which is no longer like the past where the processing is only limited to the dimension of 2.5D. Yet front sides processing and reverse side processing need to determine by whether the original planning on the pathway is ok or not, before proceed with the job. The forth step on descending the right platform by one layer thickness, its objective is to ensure that the cutting tool can work within the range at the same z-axis, at the same time to enable after stacking up the layer thickness of the second layer, to always keep the height of both left and right side to maintain on the same level plane.Within the course of every processing cycle, there are four main steps as outlined in Figure 3. The material is first inserted into the system, and then front side processing is done followed by reverse side processing descending on the right platform. This cycle is then repeated until the entire 3D workpiece is completed. This is unlike methods used in the past where the processing dimension is limited to 2.5D. However, both the front side and reverse side processing requires knowledge of whether the original plan of the pathway is suitable before proceeding with the job. The fourth step is to descend on the right platform by one layer. The objective of this is to ensure that the cutting tool can perform within the range of the same z-axis while at the same time to enable stacking of the layer thickness of the second layer and to maintain the same height on both the left and right sides to maintain a constant level plane.

Comment [WL6]: CHECK:
I'm not really sure what you mean by "collocated". Consider another word.

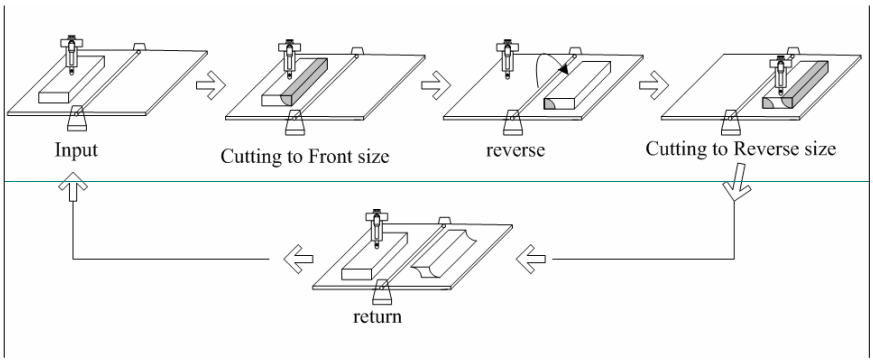

Figure 3 Double size sided processing system flow chart

Comment [WL7]: CHECK:
Why does your text refer to “front side” and “reverse side” while your figure uses “front size” and “reverse size”? Also, please correct “reverse” and “return” to “Reverse” and “Return” respectively.

II.Single layer middle point compensation method

Comment [WL8]: CHECK:
Can you use “midpoint” rather than “middle point”? If so, the use of “midpoint” is preferable.