中文摘要

本論文爲三大部分：第一部分是發展快速原型(Rapid Prototyping；RP)系統。其次是發展磨削式斷層影像擷取（Abrasive Computed Tomography；ACT）技術。最後是發展平台式印表機（Platform Printer）。所開發的快速原型系統主要有下列三項：（1）UV 樹脂噴塗式快速原型機（UV Resin Spray Rapid Prototyping System）。本系統由 UV 光源取代雷射光已大大降低 RP 成本，並且以噴頭噴塗路徑的方法減少材料浪費。噴嘴路徑除了提供製作 RP 件的新方法之外，此技術也可以發展不同的噴塗方式，以加速成型。（2）微型快速原型系統，此項技術將微機電製程所需要多項設備整合在一機中，並以 UV 光源經聚焦後以路徑掃描來減少製作光罩成本。（3）CNC 快速原型機，此項技術是應用一般 CNC 加工母機，再配合一個送料機構及貼合機構所構成的快速成型系統，此項系統不但具有 CNC 加工機高精度的優點外，也同時具有快速成型系統不受模型外觀型的限制。以上所開發的快速原型系統在軟體介面部分，主要利用現有的 CAD/CAM 系統，開發直接切層及 G-Code 加工路徑介面，此方法可降低開發時間及成本。

磨削式斷層取像掃描技術，此研究結合 CCD 取像技術以及逆向工程技術，其原理是將測量物鑲埋在顏色對比明顯的樹脂內，再利用磨削機構層層破壞，並取得每個斷層影像資料，最後依據數值運算找出測量物在各斷層之邊界線，重組 3D 電腦數據，此方法的優點克服了一般接觸式及非接觸掃描系統，無法有效掃描複雜模型的缺點。此技術應用在牙齒模型可掃描完整的全口齒模，因此在本論文中會介紹一套新的假牙與牙套製程技術，可以解決現階段製作假牙與牙套精度無法控制的問題，將此項研究稱爲 E 世代數位牙齒的新觀念。

平台式印表機主要改善捲軸磨擦進紙受到厚度限制的缺點，此方法可直接將圖案噴印在不易變形或是不易夾持的物件上。此技術加上防水墨水或是 UV 墨水便可在衣服上做各式的圖案設計，並且立即列印出來，尤其是在壓克力及一些非吸水性物質都可以進行印製，以達到簡便迅速的生產方式，比以往利用熱轉印、網版印刷及人工上色的方式更爲方便。

英文摘要

The purpose of this research was to develop system of Rapid Prototyping (RP), the technique of Abrasive Computed Tomography and the Platform Printer. The Rapid Prototyping System consists of three major machines, which are: (1) A UV Resin Spray RP machine that greatly reduces the cost of operation, such as UV light in stead of laser and nozzle spray on the path directly to avoid material waste. The files of spray path not only offer a new method of RP manufactures but also develop different ways of spray to hasten shaping. (2) A Micro-RP System that combines the Micro-Electro-Mechanical (MEM) procedure. The technique was to integrate all required equipment of MEM procedure into one mechanism and scan path by UV light source after focusing to reduce the cost of Masking. (3) A CNC RP System, which combines a traditional 3-axis CNC machine and a delivery-positioning mechanism. It has the high-precision advantage of CNC machine but not limited by the shapes of work-piece (cavity, overhanging etc.) because of the RP concept. The software interface of RP System mainly utilizes existing CAD/CAM software that develops direct slicing and G-Code processing path to perform the spraying material, process and accumulation.

The technique of Abrasive Computed Tomography (ACT) is to combine CCD image technique and reverse engineering. The principle is to submerge the sample into resin of contrasting color and use an Abrasive Machine to slice the sample structure step by step. After that, the data of each image section is collected and analyzed by the computer to form a 3D model. This system will overcome the drawback of existing contact or non-contact scanning system in the application of complex model. The technique is used specifically to produce 3D computer model of whole set of teeth in this paper. A novel manufacture technique of bridge and crown is introduced. This technique can solve the existing problem that precision is unable to control during bridge and crown manufacture. For this reason we call this research as a new concept of E-generation digital teeth.

In commercial printers, the reel moves forward with sample (paper) by friction and the gap is invariable. Therefore, the sample is difficult to be clamped and printing will fail if too thin or too thick. This Platform Printer removes thickness restriction of the sample. Therefore, it is able to print on different materials with different thickness. In this research, a variety of designed patterns were printed immediately on the clothes by adding waterproof or UV ink. Especially the machine can print on some acrylic and materials that does not absorb water. Consequently, the technology is more convenient than heated formation, halftone print and artificial paint.