Product Development Through The Use Of Rapid Prototyping

by Ir. Dr Tan Chee Fai

THE competition and rapid development of the world market is causing the industry to produce more quality innovated products in the shortest time. In the first place, the industry needs to plan and adopt the right strategy in order to reduce the time to market their products. To achieve this, different methods such as Kanban System, Total Design, Lean Manufacturing and Concurrent Engineering are used. To reduce the production time and minimise design error, engineers need to create the rapid models in each development stage.

Rapid prototyping (RP) technology is a means through which the product geometry as modelled in the earlier stages can be directly utilised to obtain the physical shape of a component. This helps explore and prevent the design problems during the manufacturing stage. Rapid prototyping allows real models and tools to be produced directly from the file of computer-aided design (CAD) data [1]. RP is very useful in the early stage of product development as well as in the final stage of product verification. The rapid product can be used for ergonomic evaluation, aesthetic checking, mechanism validation, etc.

The rapid prototyping industry is experiencing impressive growth although it was badly hit by the global manufacturing recession. As RP can support the rapid product development process, the demand of RP is growing [2]. Many RP systems are available in the market; however only a few processes are widely accepted by the industry. Among them, Strereolithography (SLA/SL), Selective Laser Sintering (SLS), Fused Decomposition Modelling (FDM), Laminated Object Manufacturing (LOM), Object Quadra system and Envision Tec Perfactory are some of the widely used systems. Yet most of the present systems have not completely addressed the industry's needs. Machines have limitations in their performances, and dimensional accuracies, surface finish, process speed and material properties have been identified as some of the major limitations [3]. This paper presents the trends, research and development, and applications of RP in recent times.

MAJOR RP APPLICATIONS IN INDUSTRY

Offshore and Abyssal Engineering

Wieneke and Gerber [4] applied RP in offshore and abyssal research. The outcome from the research found that RP has improved and replaced the conventional methods to develop new types of products and procedures. RP therefore has great potential in offshore engineering.

Engineering

The aerospace industry in the United State uses RP technology to manufacture the customized parts for the International Space Station and the space shuttle fleet. RP can also be used to manufacture parts for fighter jet for the military [4].

RP also plays an important role in the automotive industry. RP models are used for design studies (aesthetic evaluation) and physical experimentation (aerodynamic analysis). Functional parts have been used for the motors and assembly experiments [4]. In addition, RP can be developed for tooling within a shorter time such as in F1 racing model development [7].

Architecture

The Rapid Prototyping Group from University of Strathclyde of the United Kingdom has applied RP in the architectural field. The RP was used in visualising the feasibility model, planning model and final project model. The characteristics of architectural models can be described using seven criteria: scale, size, cost, time, materials, complexity and accuracy [5]. The RP technology has also been applied in the continuing construction of Gaudi's Sagrada Familia Church in Barcelona, Spain to integrate with CAD/CAM production [6].

Medical Applications

RP has been used for orthodontics application. Appearance conscious adults can have their teeth straightened without the embarrassment of having a mouth full of metal braces [4]. In addition, RP is also used in the production of crowns, bridges, and other types of dental restorations [7]. RP can also be applied in the hearing aids industry to produce customised hearing aid shells for patients. In addition, RP is also being used to produce custom-fit masks for burn victims. The RP model of a mask will fit perfectly to the patient's face which helps to reduce the formation of scarred tissue.

Arts and Archaeology

RP is being used in the restoration of artefacts. RP can duplicate ancient statues and ornaments which had suffered damage from environmental influences. The original artefacts are scanned to create 3D data, where the damage can then be corrected using the software. In this way, duplicates can be easily created [4].

Sciences

In the field of science, RP is used to model molecular

chains upscale for teaching and learning purposes in the classroom [4].

Currently, RP is not only used by big organisations and educational institutions, it is also affordable and can be used by a small company, college, school or individual. The small firm can use the low-cost RP machine to make a simple part to proof a concept. Next, for colleges and schools, students can learn the RP technology through hands-on projects. For the individual, the low-cost RP machine can be used for various projects or as a product development tool for small scale businesses such as an online business. However, the only drawback is that of the quality of the finished product will not be as good due to the low resolution of the machine. ■

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