

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Advancements in Materials Applications and Rapid Prototyping (9)

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RESEARCH ON TECHNOLOGY OF RAPID PROTOTYPING AND MANUFACTURING APPLIED
TO AEROSPACE SERVO PRODUCTS

Abstract

The launch missions in aerospace have increased greatly within recent years and development of spacecrafts requires new products to be brought quickly to a highly competitive market. The need for reduced time to market of new designs has promoted the development of a new generation of computer-aided design and manufacturing (CAD and CAM) tools which have significantly improved the traditional methods of design and manufacturing. However, there are a number of obstacles in true integration of CAD with CAM for rapid development of new products. The active solution for a substantial reduction of time or effort in the design and manufacturing process appeals to the technology of rapid prototyping and manufacturing (RPM). RPM is the development of products in significantly less time or with significantly less effort for the special types or complexity. RPM is capable of directly generating physical objects from CAD databases by adding materials rather than removing materials and fills the gap between CAD and CAM. Aerospace servo is a very important subsystem of motion execution in flight control system and servo products are characterized by small batch or various types. With the more rapid development of new spacecrafts, the servo performance requirements have been much stricter and manufacturing cycle has been much shorter. Therefore, it is very necessary to develop the novel design and manufacturing tools as new alternatives to conventional ones. For electrohydraulic servo, the mechanical shell of hydraulic actuator is typically characterized by being full of complex hydraulic paths for oil flowing inside itself. However, it is very difficult to drill these oil paths in a restricted interior space of shell. It is obvious that RPM technology can eliminate the difficult cutting for these oil paths and a prototype of hydraulic actuator can be produced directly from its CAD model by simplifying the mechanical machining process to 2D layer adding process. This paper presents an integrated system of RPM for servo products in order to reduce substantially product development time and improve flexibility for manufacturing small batch or various types. The key technologies comprising rapid prototyping, tooling, precise casting and precision control are dissertated and verified successfully by casting the mechanical actuator shells following the original prototypes. These physical entities of special servo mechanical parts are produced directly and rapidly from CAD model in order to meet the requirements of visualization, sample trial-manufacture, performance evaluation and small batch manufacturing for various types.