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Implementation of Reverse Engineering for Crankshaft Manufacturing Industry*

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Abstract

In this modern world, there are always pressure on the designers and the manufacturers to respond to the consumer needs. Engineering involves designing, manufacturing, constructing, and maintaining of products, systems, service and structures. In this paper, an attempt has been made to derive all the parameters, which are necessary for designing the components of an engine using reverse engineering. Even though lots of methods are available for redesigning, the reverse engineering is selected. Computer aided modeling using CATIA and optimization analysis of crankshaft is used to study was to evaluate and compare the fatigue performance of three different materials of automotive crankshafts, namely forged steel, ductile cast iron and aluminium alloy. In this study a dynamic simulation was conducted on three crankshafts, cast iron and aluminum alloy forged steel; from similar single cylinder four stroke engines. The dynamic analysis was done and was verified by simulations in ANSYS. Geometry, material and manufacturing processes were optimized considering different constraints, manufacturing feasibility and cost.The maximum stress point and dangerous areas are found by the deformation analysis of crankshaft. Possible weight reduction options and their combinations were considered. Thus durability of feasible material and analysis is carried after weight reduction carried to the feasible material. Thus more possibilities of feasible crankshaft are found out.

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Keywords: Reverse engineering, CATIA, ANSYS, Optimization

1. Introduction

1.1 Reverse Engineering

Reverse engineering (RE) is a new concept that denotes the process of generating engineering design data from existing components. This term is used to describe the process in which product development follows a reverse order. Rather than the conventional production drawing, the existing product is the starting point. RE can be treated

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as the process of analysing a system to identify the system's components and their interrelationships, create representations of a system in a new modified form, and create the physical representation of the damaged parts. RE is having applications in the following fields like software engineering, automotive, consumer products, microchips, chemicals, electronics, and mechanical designs.

B. Vijayaramnath et al [1] done the data acquisition using laser scanner device. The data sculpt software draw profile lines using scanned data. Initially, AHP is carried out to find suitable process among RE, reengineering and conventional design. The result of AHP shows that RE is suitable. In general, the RE can also be used to find the dimensions of broken and damaged parts. Gopinath Chintala and Prasad Gudimetla [2] have found that Ti is best material for gas turbine blades for the centrifugal forces considered in this study as it possesses outstanding properties of structural stability when exposed to varying temperature and fatigue loads, and also possesses maximum strength at high temperatures. Bruneliere et al [3] have presented the MoDisco that offers a generic and extensible model-driven reverse engineering (MDRE) framework intended to facilitate the elaboration of MDRE solutions actually deployable within industrial scenarios. Beniere et al [4] have introduced a new formalism to define the topology of the object and compute the intersections between primitives. Rosen et al [5] have proposed a method for the construction of material models from microstructure images, which can be integrated into a heterogeneous CAD representation. PengFei et al [6] have described about an improvement is made to difference expansion technology to make it suitable for two-dimensional (2D) computer-aided design (CAD) engineering graphics. Barbero [7] have found that rather than by employing complex mathematical algorithms, a fit is achieved by drawing a parametric outline that complies with the design intent, and by adjusting the different parameters through successive approximations using commercial CAD software commands. Giovanna Sansoni and Franco Docchio [8] have described a very special and suggestive example of optical three-dimensional (3D) acquisition, reverse engineering and rapid prototyping of a historic automobile, a Ferrari 250 Mille Miglia, performed primarily using an optical 3D whole-field digitizer based on the projection of incoherent light (OPL-3D, developed in our laboratory). Lin et al [9] have applied a developed reverse engineering approach, the modified adaptive model-based digitizing process (MAMDP) to the 3D geometric design of turbine blades. Fatemi et al [10] have studied a dynamic simulation on a forged steel crankshaft from a single cylinder four stroke engine and the dynamic analysis was resulted in the development of the load spectrum applied to the crankpin bearing and the load was then applied to the FE model and boundary conditions were applied according to the engine mounting conditions. Gaska et al [11] have reported many type of errors could be compensated using an approach that includes - probe head errors, machine dynamics errors and, most importantly, machine geometrical errors. Zheng et al [12] the high precision measurement results can be realized by using a low-precision measuring machine without any increase in hardware manufacturing cost. This is of great theoretical value and practical significance for the flexible CMM's further development. Young et al [13] have proposed a CAMP for effectively gauging the inspection points based on the ruled line information of the impeller blade surfaces. Balamurugan et al [14] has conducted a dynamic simulation on two crankshafts, cast iron and forged steel, from similar single cylinder four stroke engines and the finite element analyses was performed to obtain the variation of stress magnitude at critical locations. Shih-Wen Hsiao and Jiun-Chau Chuang [15] have developed 3D product models based on their ideas with polyurethane or polystyrene foam first and the data points on the surface of the product were then measured using a non-contact 3D scan device, and the point clouds for 30 crosssections of these products are obtained based onthe measured information

1.2 Measurement using CMM

The crankshaft material which selected doesn't have accurate data. Hence, in this work RE method has been used to obtain the preferable data. A complete data of the product must be built in order to represent the CAD model. The crankshaft consists of different geometric proportionssince they are very intricate in dimensions the CMM requires to handle the parts with greater accuracy. The cloud points are carried in CMM were to be noted.These points should be noted as minimum as possible. Normally the crankshaft of different formation. They have circular, cone and more complex shapes in order.