8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

MESHING STIFFNESS AND STRESS ANALYSES OF HERRINGBONE GEARS

Wu Liyan[1], Liu Geng[1] and Bu Zhonghong[1]

[1]School of Mechatronic Engineering, Northwestern Polytechnical University,
PO BOX 324, NO.127 ,Youyi Xi Road, Xi'an, 710072, China
wuliyan@nwpu.edu.cn, npuliug@nwpu.edu.cn, bzh1014@mail.nwpu.edu.cn

Key Words: *Herringbone Gear, Meshing Stiffness, Stress, Finite Element Method(FEM), Parametric, Planetary Gear Trains(PGTS).*

ABSTRACT

Herringbone gears, also known as double helical gears, are widely used in a large number of gear sets in heavy machines[1]. They process numerous advantages over helical gears including larger total contact ratio, high load capacity and no axial force with large helical angle.

Meshing stiffness and stress are essential for vibration and strength analysis which become the key concerns in the application of herringbone gears. A parametric method for meshing stiffness and stress analyses based on finite element method (FEM) is proposed in this paper.

A three dimensional model of herringbone gear structure is established based on the curve equations for true involute profile and transition curve. The curve equations for external and internal gears are generated according to the hobbing and shaping technics respectively. The model can be easily changed in terms of the basic geometry parameters.

It is commonly known that the total deformation of each contact point at the same meshing position along the load direction must be the same to ensure the continuity of the meshing process[2]. An automatic program to determine the meshing positions and the coordinates of each contact point is developed firstly[3]. The flexibility factors for gear flank are computed by using FEM. The whole process is implemented by using FEM commands of ANSYS which are managed by the APDL program language and macros technique.

The program constructing the flexibility matrixes and solving out the meshing stiffness and load distribution is developed. By using the progam, the meshing stiffness and load distribution along the contact lines and load sharing ratio of each gear tooth during the whole meshing period can be obtained simultaneously.

Based on the load distribution, the gear stresses are analyzed by the finite element model of whole gear structure. The stress and deformation contours are displayed using the post-treatment of ANSYS.

In the end, techniques developed in this paper are used to analyze the meshing

stiffness and stresses of herringbone gears used in encased planetary gear trains (PGTS). The 3D models of every parts of PGTS are established and used to assemble the virtual prototype which simulates the movement of the PGTS. The meshing stiffnesses of sun gear wheel with planet gear pairs and planet gear pairs with ring gear pairs, and the stresses of sun gears, planet gears and ring gears are calculated to highlight the capabilities of the developed techniques.

REFERENCES

[1] Wang Shi-an,Tian Guang, You Ke-quan,et al.Development tendency of marine gear design technology. Journal of Engineering for Thermal Energy & Power, 2003,18(6): 547-551.

[2] Liu Geng, Shen Yunwen. A method for automatic 3-D finite element mesh generation of external or internal helical gears and its implementation. Chinese Journal of Mechanical Engineering, 1992, 28(5): 20-25.

[3] Liu Geng. An effective method for dertermining the load distribution of extrnal and internal helical gears. Chinese Journal of Mechanical Engineering, 1991, 27(3): 20-26.