



航空学报 » 2001, Vol. 22 » Issue (1) :64-68 DOI:

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齿轮减速器系统可变固有特性动力学研究

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DYNAMIC ANALYSIS OF VARIABLE NATURAL CHARACTERISTIC FOR GEAR DECELERATOR

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摘要

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摘要 考虑到齿轮传动啮合刚度的波动和传动误差的影响以及轴承支撑刚度的作用,对二级齿轮减速器传动系统进行了理论建模和动态响应分析,并与实验结果进行了比较。结果表明,齿轮传动在单齿啮合区和双齿啮合区之间啮合刚度变化较大;减速器系统的动态特性(固有频率、固有振型、阻尼等)随啮合周期而发生变化,呈现出一种可变的动态固有特性。故对于系统进行研究时,可分别按单齿区和双齿区平均啮合刚度进行分析,一般可以满足实际工程要求。

关键词: 齿轮减速器 时变啮合刚度 传动误差 轴承刚度 动态固有特性 动力学分析

Abstract: A gear decelerator is a complex elastic system with multiple transmission. Its dynamic characteristic appears as nonlinear varying phenomena because of the nonlinear influence of gear meshing stiffness and transmission error as well as the nonlinear action of bearing supporting stiffness. The system stiffness was analyzed always by a fixed constant method; in fact, it did not accord with the practice of engineering. In this paper, the fluctuation of gear meshing stiffness, the influence of transmission error, and the action of bearing supporting stiffness are considered all together. And the theoretic modeling and dynamic response analysis are done for the transmission system with bi grade taper cylinder gears. The nonlinear terms of the transmission error are dealt with the method of Fourier series expansion. Furthermore, the theoretic analysis is compared with the experimental results. It is shown that the meshing stiffness of gear transmission varies evidently between the single toothed meshing zone and double toothed meshing zone, but it varies slowly in the same meshing zone. The dynamic characteristics of the decelerator, i.e. the natural frequency, the mode shape and so on, vary with meshing period. It appears to be a variable natural characteristic. Therefore, the multiple gear transmission system shall be analyzed according to the mean meshing stiffness of the single toothed meshing zone and double toothed meshing zone respectively, and in doing so, it may meet the requirements of engineering.

Keywords: gear decelerator meshing stiffness transmission error bearing stiffness dynamic natural characteristic dynamic analysis

Received 1999-09-28; published 2001-02-25

引用本文:

邵忍平;沈允文;孙进才. 齿轮减速器系统可变固有特性动力学研究[J]. 航空学报, 2001, 22(1): 64-68.

SHAO Ren-ping; SHEN Yun-wen; SUN Jin-cai. DYNAMIC ANALYSIS OF VARIABLE NATURAL CHARACTERISTIC FOR GEAR DECELERATOR[J]. Acta Aeronautica et Astronautica Sinica, 2001, 22(1): 64-68.

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