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基于传动误差设计的弧齿锥齿轮啮合分析

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TOOTH CONTACT ANALYSIS OF SPIRAL BEVEL GEARS BASED ON THE DESIGN OF TRANSMISSION ERROR

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摘要

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摘要 提出了基于传动误差设计的弧齿锥齿轮啮合质量控制的新概念。首先分析了传动误差所反映的弧齿锥齿轮传动的动态特性、强度性能等众多信息,包括设计重合度、实际重合度、振动激励、边缘接触、载荷齿间分配和齿面印痕相对于误差的敏感性。在此基础上,提出了高重合度传动误差曲线的设计,通过齿面接触路径方向的倾斜,重合度能够高至 2.0~ 3.0,有效地改善了齿轮动态特性,提高了强度。进一步又提出了几何传动误差曲线幅值的设计,结合承载传动误差,使齿轮在不同载荷条件下既能具有高的重合度,又保证了相对低的误差敏感性。其后提出的四阶传动误差曲线的设计,除上述优点外,还改进了齿轮的轻载振动和噪声。最后论述了基于传动误差设计的弧齿锥齿轮的相应制造方法。该研究为高性能弧齿锥齿轮的开发开辟了途径

关键词: 弧齿锥齿轮 传动误差 重合度

Abstract: The traditional design, manufacturing and examination of spiral bevel gears depend frequently on the position and size of the contact pattern on tooth surfaces. In this paper, a new designing concept based on the transmission error is presented. Firstly, the information on dynamic characteristics and strength behavior reported by the transmission error, such as designed contact ratio, real contact ratio, vibrating excitation, load share between tooth pairs and sensitivity of the contact pattern to the error, is analyzed. Based on the analysis mentioned above, three types of designs on transmission errors are presented. They are: (1) A parabolic transmission error curve with a designed width between two ends, which is obtained by inclining the direction of the contact path on the tooth surface. It results in a contact ratio of 2.0-3.0 and the improved dynamics and strength behavior. (2) A parabolic transmission error curve with the designed amplitude, which is obtained by controlling the relative curvature of tooth surfaces along contact path. It results in a low sensitivity of contact pattern to error, as well as a high contact ratio under operating and maximum loads. (3) A fourth order transmission error curve with the designed width between two ends and amplitude, which can be obtained by CNC machine. It results in an improved dynamic behavior under light load, as well as the superiorities mentioned above. An approach to designing the spiral bevel gear drives with high performance is advanced.

Keywords: spiral bevel gear transmission error contact ratio

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