기어박스 구동 툴홀더의 모델링과 해석
Modeling and Analysis on the Gearbox of Driven Tool Holder

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Key words : Drive Tool Holder, Gear, TE (Transmission error), Modal Shape

1. Abstract

Driven tool holders are designed for various applications of milling and drilling processes on CNC lathes or Swiss type machines, available in VDI/DIN 69880 standards or some particular machine manufacturers. They are mounted on a turret or on a gang tool post. The VDI tool holder retention system provides an accurate and rapid method of affixing tools to the turret plates.

In recent years, there have been considerable developments in computer aided design (CAD) and computer aided engineering, as a result, engineering can now easily undertake a wide range of design, modeling and analysis in respective research areas. In this paper, in order to reduce the driveline noise of the noise excitation mechanism, an advanced algorithm is used to predict and optimize the TE of a gear pair and the system response of specified TE excitation is investigated for the driven tool holder.

2. Gear Noise and Analysis Approach

In today's demanding and flexible manufacturing environments, fast changeover and set-up times are essential in order to stay profitable. The round serrated tool holder shank fit into tool pockets which are located on the face or edge of the tool plate clamping mechanism using a single Allen wrench to achieve precise, rigid and secure locking of the tool holder. The cad model is shown in Fig. 1.

In the software, the boundary conditions of the analysis are defined when the model is completed. For the static analysis, it allows the users to specify the input speed and torque (power). The full-system quasi-static analysis is performed at each rotational position of the transmission. This analysis includes the effects of time-varying misalignment due to shaft, bearing and housing deflection.

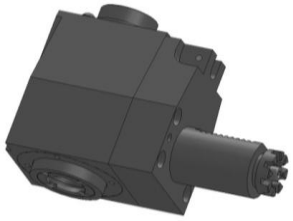


Fig. 1 The CAD model of the driven tool holder

3. Modeling and Simulations

The step in the design and optimization of the housing is to get a design model in CAD software (Fig. 1). The model includes the essential packaging constraints, manufacturing considerations and design features in order to maximize the material flow possibilities for the optimization process. And the model was then meshed in Hypermesh with designable and non-designable areas. The material's Young's modulus is 78 Gpa and Poisson' ratio is 0.3. The tool holder's housing is locked into the turret by the hardened and ground serrated wedge, as illustrated in the paper before, securely pulling it back to the surface of the turret. Fig. 2 is the CAE model of the driven tool holder.

Based on the static analysis, the gear pair under different load conditions was calculated. And the static transmission error of different speeds was obtained by gear micro-geometry analysis. Fig. 3 is the static transmission error of

the load cases. It indicates the highest displacement in line of action (LOA) is about 12.8um in the first load case. Frequency has high level of dynamic TE means that the whole system can be excited easily. From the Fig. 4, different dynamic TE from 324.7Hz to 1809.3Hz could be obtained. The whole system modal shape for two critical frequencies (688HZ and 891.4Hz) is shown in Fig. 5.

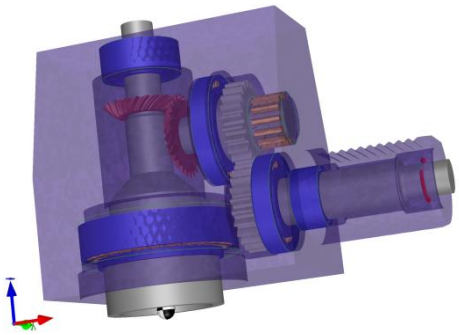


Fig. 2 CAE model of the driven tool holder

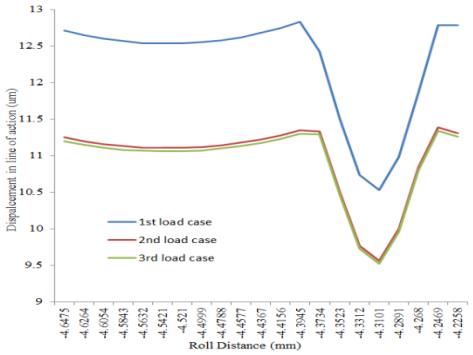


Fig. 3 Transmission error under the load cases

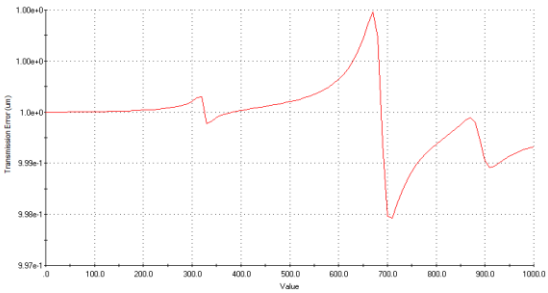
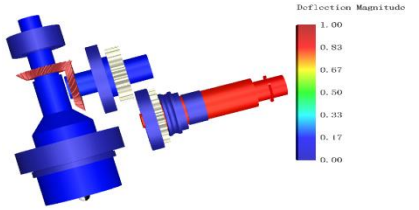
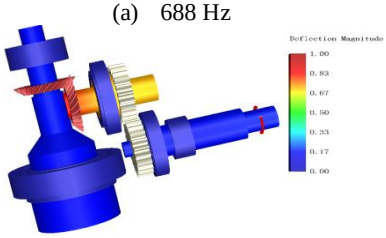


Fig. 4 The dynamic transmission error under 1st load



(a) 688 Hz



(b) 891.4Hz

Fig. 5 Modal shape of driven tool holder

4. Conclusions

In this paper, the driven tool holder was modeled and analyzed in the completely virtual model. A pair of spur gear has been investigated through static and dynamic analysis in detail. The system response of specified TE excitation is also investigated for the driven tool holder system. Thus, it is helpful for engineer to understand and control the gear whine of the whole system.

Acknowledgements

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