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Transmission Error in Gear

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ABSTRACT: *The power transmission by the gears is mostly used in the industries, automobile gearbox, robotics office automation etc. and this is possible mostly by the gearing. Gearing is one of the most critical components in mechanical power transmission systems. Transmission error is to be one of the main contributors to noise and vibration in gear set. This paper aim is to know about the gear "Transmission error". Transmission error is considered to be an important excitation mechanism for gear noise and vibration. The definition of transmission error is "the difference between the actual position of the output gear and the position it would occupy if the gear drive were perfectly conjugate". The gear transmission error that widely occurs in the actual gear system which arise because of irregular shape tool geometry imperfect mounting misalignment of two gear and so on. The influence of transmission error cannot be determined by investigating the gears only.*

I. Introduction

Gearing transmissions have a long history dating back since the time of the first engineering systems. Their practical usage in the present day modern engineering system is enormous. In accordance with a contemporary development of mechanical engineering techniques ever growing requirements and working specifications. Along with modern high speed manufacturing industry development, gear are used widely in many applications ranging from automotive transmission to robot and aerospace engines. Different kinds of metallic gears are currently being manufactured for various industrial purposes. Seventy-four percent of them are spur gears, fifteen percent helical, five percent worm, four percent bevel, and the others are either epicyclical or internal gears. The main purpose of gear mechanisms is to transmit rotation and torque between axes. The gear is a machine element that has intrigued many engineers because of numerous technological problems arises in a complete mesh cycle. If the gears were perfectly rigid and no geometrical errors or modifications were present, the gears would result in a constant speed at the output shaft. The assumption of no friction leads to that the gears would transmit the torque perfectly, which means that a constant torque at the output shaft. No force variations would exist and hence no vibrations and no noise could be created. Of course, in reality, there are geometrical errors, deflections and friction present, and accordingly, gears sometimes create noise to such an extent that it becomes a problem. Transmission error occurs when a traditional non-modified gear drive is operated under assembly errors. Transmission error is the rotation delay between driving and driven gear caused by the disturbances of inevitable random noise factors such as elastic deformation, manufacturing error, alignment error in assembly.

II. Transmission Error

Theoretically, for two gears with perfect involutes and an infinite stiffness, the rotation of the output gear would be a function of the input rotation and the gear ratio. A constant rotation of the input shaft would therefore result in a constant rotation of output shaft. Due to both intended shape modifications and unintended modifications, such as manufacturing errors, gears will be a motion error of the output gear relative to the input gear.

The transmission error and mesh stiffness variation is often considered to be the primary excitation of gear noise and a minimization of the transmission error is believed to minimise noise. The definition of transmission error is "the difference between the actual position of the output gear and the position it occupy if the gear drive were perfectly conjugate". The transmission error can be measured statically or dynamically, unloaded or loaded shown in the table.

		Load (Torque)	
		Low	High
Speed	Low	Static unloaded	Static Loaded
	High	Dynamic Unloaded	Dynamic Loaded

III. Static Transmission Error

The main source of excitation in gearboxes is generated by the meshing process. Researchers usually assume that transmission error and variation in gear mesh stiffness are responsible of noise radiated by the gearbox. The transmission error characteristics depend on the instantaneous situations of the meshing tooth pairs. Under load at very low speed (static transmission error), these situations result from tooth deflections and manufacturing errors.

Under operating conditions, the mesh stiffness variation (due to variations in the length of contact line and tooth deflections) and the excitation located at teeth mesh point generate dynamic mesh force which is transmitted to the housing through shafts and bearings. Noise radiated by the gearbox is closely related to the vibratory level of the housing.

Predicting the static transmission error is a necessary condition to reduce noise radiated from the gearbox. Various researchers deals with estimation of static transmission error and mesh stiffness variations of gears. They are worked based on a 3D finite element analysis of tooth deflections, using two different modelling and solvers.

Two methods are used to solve the static equilibrium of the gear pair, in order to estimate load distribution and static transmission error, for a set of successive positions of the driving wheel. Different modelling of a generic gear pair have been built in order to analyse the effect of wheel body deformation and interactions between adjacent loaded teeth. They have found satisfied results.

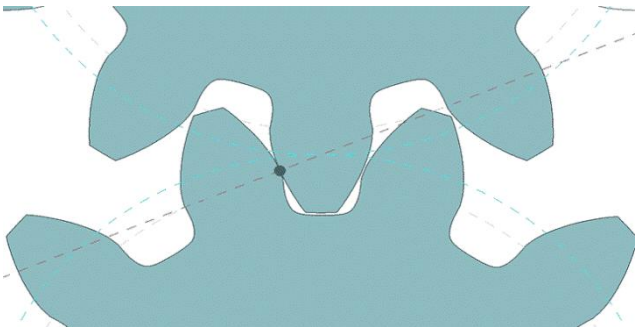

Figure-1

IV. Dynamic Transmission Error

The most relevant transmission error measurements for noise and vibration predictions are probably the dynamic. When measuring dynamic transmission error, the gears should be in the gearbox, because the dynamical properties of the system consisting of gears, shaft, bearings and casing are important. Dynamic transmission error is taken as the parameter for the modelling of noise in geared transmission. In the last two decades there is plenty of work has been concentrating on modelling of the dynamic transmission error for spur and helical gears and representing the influence of the dynamic transmission errors on the level of noise in the geared transmission. Lately, there have been several experiments conducted in order to isolate particular noise effects like noise, meshing action noise and backlash noise simply by measuring the dynamic transmission error. For different analysis purpose, there are several modelling choices such as a simple dynamic factor model, compliance tooth model, torsional model, and geared rotor dynamic model. Using the free vibration analysis critical parameters such as natural frequencies and vibration modes that are essential for almost all dynamic investigations can be calculated.

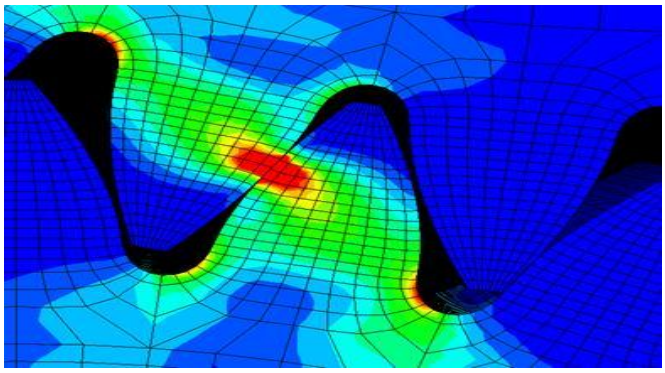

Figure-2

V. Conclusion

The contribution of this paper work presented here can be summarized as follows the aim of the work is highlight factors to generate the transmission errors in gears and its adverse effect on the gearing. There are various points consider to cause of transmission error is generate in gearing. First problem is very common do not proper mountings of gears for conjugate action, manufacturing error during operation such as milling of gears, hobbing of gears etc., tooth mesh stiffness and load variation on the gears. These problems to radiate noise and vibrations during operating condition of gears. In this paper to review literary, various papers to overcome the transmission error and its effect. Thus the static transmission error overcome by the proper mountings of gears for proper meshing and the dynamic transmission error overcome by the modelling of the gears on FEM.

Aknowledgement

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