Parametric instability of face-gear drives with a spur pinion

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Abstract

This paper investigates the parametric instability behavior of face-gear drives by modeling pinion and face-gear tooth geometry and kinematics. The out-of-plane dynamics of the face-gear are excited by periodically time-varying gear tooth mesh stiffness variations. Here an annular spinning Kirchhoff plate with centrifugal stiffening effects and a moving spring is used to model the face-gear and Floquet theory is employed to determine the system stability. Additionally, this paper considers the maximum bending stresses at the root of pinion tooth to restrict the face-gear size. Tregold's approximation is utilized to calculate the contact-ratio of face-gear drives. Finally, an example of a prototypical helicopter face-gear drive is studied at different operating speeds. The results characterize the parametric instability regions as a function of rotation speed and face-gear disk thickness. Moreover, the minimum critical thickness to sustain the system stability over the entire operating speed region is determined. The analysis and results provide new and important insights into the dynamics and design of lightweight face-gear drives.
Involute Spur Gear Template Development by Parametric Technique

Keywords: Parametric design, Template gear, involute curve, x and y co-ordinates, Laws for x and ... The use of face gears in power transmission and drive systems has a significant number of benefits. Face gears allow a variety of new transmission arrangements as well as high reduction ratio capability. The work considers face gears in mesh with spur involute pinions for both intersecting axes and offset drives. Tooth geometry, kinematics, generation of face gears with localized bearing contact by cutting and grinding, avoidance of tooth undercutting, avoidance of tooth pointing, tooth contact analysis, and algorithms for the simulation of meshing and contact are all topics which are discussed. This paper investigates the parametric instability behavior of face-gear drives by modeling pinion and face-gear tooth geometry and kinematics. The out-of-plane dynamics of the face-gear are excited by periodically time-varying gear tooth mesh stiffness variations. Here an annular spinning Kirchhoff plate with centrifugal stiffening effects and a moving spring is used to model the face-gear and Floquet theory is employed to determine the system stability. Additionally, this paper considers the maximum bending stresses at the root of pinion tooth to restrict the face-gear size. A face-gear drive with a spur pinion is considered as a particular case of the developed theory. A new method of grinding or cutting of face-gears by a worm of special shape has been developed. A face gear drive, which is a kind of intersection gear drives with an involute spur pinion, is one of the significant gear drives due to its insensitive characteristics of manufacture and alignment errors versus spiral bevel gear drives and is addressed by scholars. There are a vast number of manuscripts discussing face gear drives in the past few years.