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Commentary

Optimization of Gear Box Design Using Heuristic Approaches

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DESCRIPTION

Optimization can be considered as an act of selecting optimal results under given conditions. In the design and development of various technical systems, many specialized decisions have to be taken. The final aim of such specialized decisions is to optimize the various parameters to maximum the necessary benefits. Normally the desired benefits are expressed as a function of appropriate variables. Hence optimization may be defined as the process of finding conditions which result in maximum or minimum value of the function. At times, a system may have more than one objective to be optimized. This requirement led to the development of a Multi-objective Optimization Method (MOM) and various algorithms were developed to achieve the multi objective optimization. Simulated annealing genetic algorithms and neural networking have recently developed mathematical tools for solving multi-objective optimization method. Minimum noise control objectives, interference in meshing objectives are some of the objectives considered for optimal design of gear boxes and speed reducers. The genetic algorithms involve search techniques based on the mechanics of natural selection and natural genetics.

A wide scope exists for optimization in many engineering applications including optimal design of linkages, gear etc. Optimal design of a gear transmission system involves selecting combinations of gear drive parameters to satisfy the given objectives. Developing compact gear sets is another important area, requiring optimal design of key parameters like the centre distance between the input and outputs steps, width of gear tooth, number of tooth on pinion and gear etc. This optimization essentially is a multi-objective in nature. The centre distance and weight of the gear drive are to be optimized. Optimal design of gear box/drive must satisfy the constraints such as minimum induced bending stress, high pitting resistance and satisfactory thermal properties of the lubricant used in the gear box. The optimal design also addresses issues involved in non-standard spur gear sets.

The design, development and optimization model for computing the centre distance, width of gear tooth, module, number of teeth etc., are discussed. The present work is restricted to optimization of the parameters namely centre distance and weight of gear transmission system. The multiobjective optimization problems of helical, bevel worm and wheel drives will be taken up as future work. The proposed multiobjective optimization for future work includes the maximum power transmission and efficiency of the drive.

CONCLUSION

A properly designed and manufactured gear should never be overheated or produce much noise operation. Typical failures of gear tooth are breaking off, pitting, abrasion and seizure. Teeth mainly break off due to fatigue. Each time the tooth engagement it is subjected to varying load. Hence alternating bending stresses are developed at the root of the teeth. A crack is liable to create in the territory of most extreme anxiety fixation. In the event that the course of rotation is unaltered the contact is made each time on one side the tooth, and the crack as a rule happens in the tension zone. Under occasional overloads, failure of this type of observed in toothed wheels. Due to inaccuracy in machining of teeth, contact between meshing teeth will not be perfect which results in load concentration along the edge. This may cause breaking of teeth. Misalignment and deformation of gear parts may also cause rupture. Surface abrasion is the wear on the working surfaces. The flanks of the teeth will be affected by attrition due to sliding of the teeth and contact compressive stress of these surfaces.

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