A NON-LINEAR FINITE ELEMENT APPROACH TO GEAR TOOTH LOAD SHARING PROBLEM

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ABSTRACT

Increased emphasis on lightweight, high power-to-weight ratio requirements in modern day helicopters, has led to improved materials and lubricants, as well as advances in gear design and manufacturing technology.

In the area of gear design, increasing load-carrying capability has been achieved by going from low to high contact ratio gears. Here, gear mesh and the pairs of teeth in contact alternates from one for low contact ratio gears, to two or three for high contact ratio gears. By distributing the load among more than one tooth, and with due consideration to pitting and scoring, one can increase the load carrying capacity with little or no weight penalty in most instances.

Manufacturing tolerances, tooth errors, profile modifications, and system misalignment will significantly influence the proper distribution of load among the teeth in contact. Perfect load sharing, of course, can only occur with perfect accuracy and tooth modification. Lack of load sharing, implies that one has to modify the geometry factor (which evaluates the shape of the tooth, the amount of load sharing between teeth, and root stress concentration effects, used in gear strength computations.

Accurate calculation of load sharing among meshing tooth pairs, especially for lightweight, thin-rimmed gears, is one of the main problems facing gear designers. The present paper formulates the gear tooth load sharing problem into a static, geometrically non-linear model, in an attempt to predict the load carrying capability including the effect of load induced gear and rim deflections.

Distribution of load across the gear face, as well as among the gear teeth (Load Sharing), were computed using Gap elements and Sol 66 of MSC/NASTRAN.